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Fall 2008
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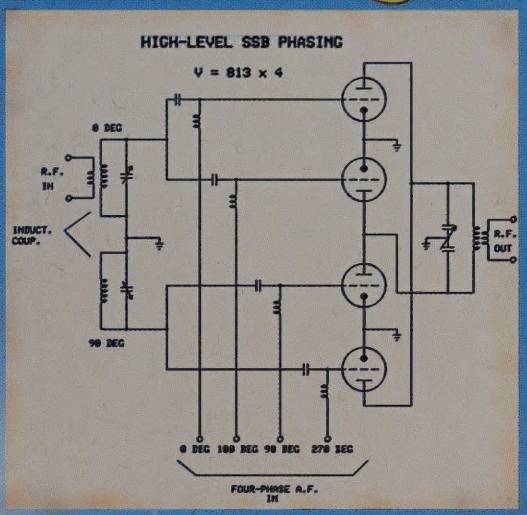
Journal of the QRP Amateur Radio Club International

SSB Phasing Tech



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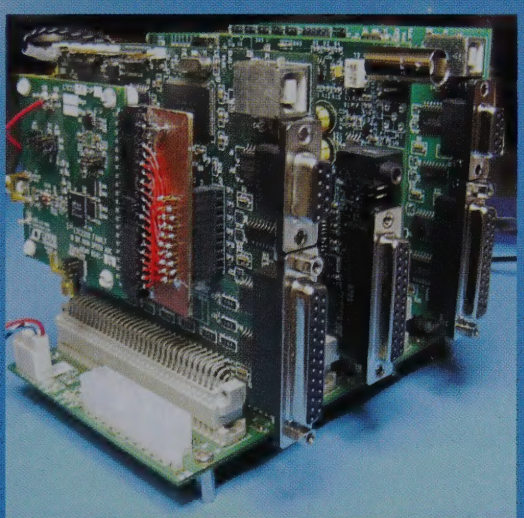

2008

So what's new?

- Learn the I's & Q's of Phasing from VK6APH
- WØRSP Describes his 40 Meter ZPole Antenna
- How Do Projects Start? KB1GMX Reveals All
- Build A RAMU! (What's a RAMU? See page 33)
- There's Nothing Easier Than AltAir, Says RV3GM

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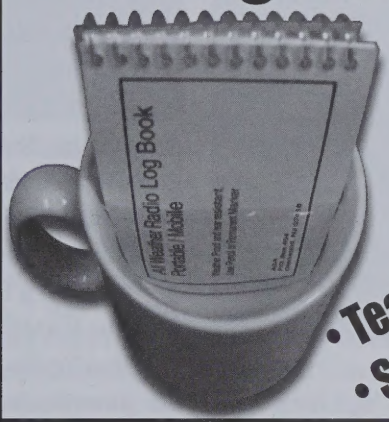

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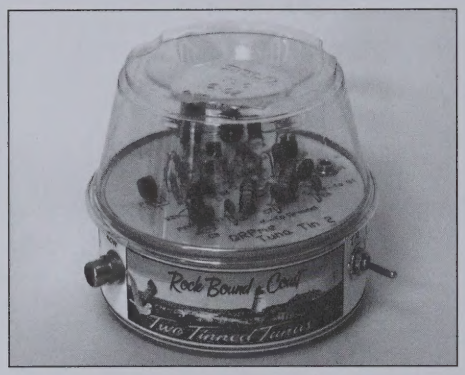

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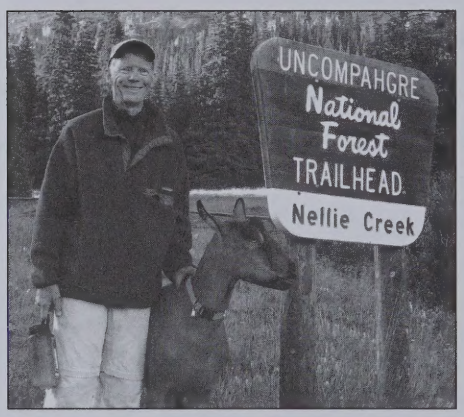

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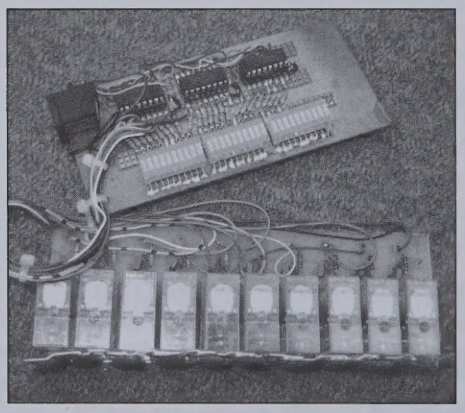

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From the Editor's Desk

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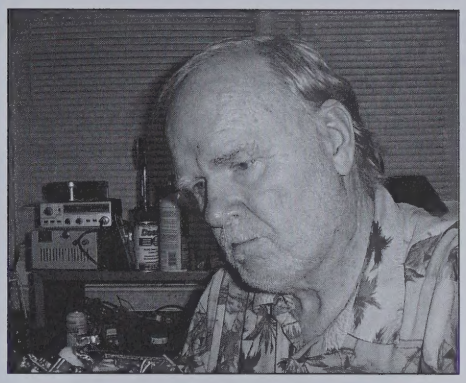

As ham radio operators, we have played a significant role in the advancement of technology, as much as any organized group of enthusiasts I can think of. Sometimes we forget that. When I was introduced to ham radio, I was vaguely aware of some of the history from reading The Radio Amateur's License Manual, and my Elmer also did some homebrewing and experimenting.

Many of us have an avid interest in building our own equipment. There are some in our community who have truly taken it to another level; in fact, being on the leading edge of the development and refinement of radio technology. But I am pretty sure that some among us are not truly aware of the significant role that hams have played, and why. It is very easy to appreciate the fine equipment available to us from commercial manufacturers and the advancement in features and capabilities of amateur radio gear. That is paralleled, of course, by the engineering advances in microchips and the technologies that employ them. We've come a long way from the first combination of transistor gates into integrated circuits, to microprocessors and special application devices that allow digital signal processing, which is currently on the leading edge of the features that we enjoy.

One specific example where hams have played significant roles in technological advancement is working with the mathematical equations of sines and cosines to employ what is an alternative to using crystal filters for generating SSB and allowing single signal reception using simple direct conversion receivers. Most of us are aware of the "phasing method." Articles in ham magazines and handbooks have highlighted it in the last few years. *QRP Quarterly* has featured SSB phasing-based transceivers at least twice in the year that I have been editor: Paul Alexander, WB9IPA's 60-meter transceiver, and the product review of the JUMA TRX2. Also, Rick Campbell, KK7B's DC receivers and complementary transmitter designs were published in *QST* and have been available in kit form through Kanga US.

So, this is really impressive new technology, right? Well, impressive, certainly, but new? Not so fast. I'm not going to delve into the specifics… and certainly not the mathematics… of phasing. In this issue, you will find that Phil Harman, VK6APH, covers that very understandably. Phil's article "Phasing Techniques in the Digital Age" discusses phasing as used in direct conversion receivers, and it also introduces some other interesting concepts. I had the pleasure of meeting Phil at Four Days in May this spring. After talking with him, I started thinking about the phasing method more and more. I recalled that my first exposure to ham radio back in 1959 was speaking to a ham in Europe at my Elmer's house, and we were using a Central Electronics 20-A as an exciter. The early CE exciters are classic phasing rigs that are much appreciated by boatanchor collectors. There were several others that I remember, like the Hallicrafters HT-37, which used later by my Elmer. However, at the turn of the decade, the shift was well underway to the use of crystal filters in SSB rigs. At that time, they were less expensive for the manufactures to produce, they could provide better sideband suppression, and it was easier to achieve and maintain the necessary tolerances to make the system work.

As I continued to think about it, I started doing some online research to try to find out more of the history of phasing; when it began and what kind of technology was used. Interestingly, I found an article by Gary Breed, K9AY, who you know as the author of our Antennas 101 series in *QQ*.

(continued on next page)

QRP News

Kanga US Recovery Status

Kanga US is slowly coming back to life this fall. As of September 1 (when this is being written) the following products are available: DK9SQ masts and antennas, ARRL books, Hands On Radio Parts Kits, Tormet Engineering products (DDSv4 and books), TiCK Keyers, and CW Touch Keyers. By the time this issue of the *QQ* gets published, I will have started to rebuild my line of kits by KK7B, W7ZOI, and AAØZZ. There are plans in the works for several new products to be introduced at Dayton 2009.

I am completely re-doing my Web site (www.kangaus.com), and as products come on-line they will be put on the Web page. I would like to thank the QRP Community for their understanding, support, and encouragement as Kanga US recovers from the flood of 2007.

—73, Bill, N8ET

QRP ARCI Awards Report

As usual, the quarter has moved by very fast. Between the summer activities such as vacation down at the Outer Banks, Field Day, and being hired to work for the Navy as an Information Assurance Technician, and of course FDIM, I have had a fairly hectic summer.

Now for awards for this Quarter: Six Thousand Miles per Watt certificates were awarded. That's about it for this quarter. Keep those submissions coming.

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3012 WA8OFU worked WØEPC on 7 MHz CW for a distance of 1512 miles per watt.

3013 N1PQ* worked W8PBO on 7 MHz CW for a distance of 1170 miles per watt.

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3017 NF8M worked ZM1A on 14 MHz CW for a distance of 2370 miles per watt.

* Indicates milliWatt Endorsement

—Jeff Embry, K3OQ

●●

(From the Editor's Desk, continued)

The article is "A New Breed of Receiver," in the January 1988 issue of *QST,* and it describes the design and construction of a phasing-type direct conversion receiver. Gary mentioned that the earliest ham radio transmission of SSB was in 1947, and in the July 1948 *QST,* Donald Norgaard, W2KUJ, described the phasing method for SSB reception. I searched my bookshelves, as I have some old technical books, and I found the 1949 *Radio Handbook,* the 12th Edition. What it covered with regard to SSB and phasing gave me the inspiration for this column's content. But I found something that was more significant than just the description of technology: the expression of the ingenuity of ham radio operators to accomplish something different.

If you go back and look at the cover of this issue, you should find it to be less mysterious by now. Phasing technology wasn't new in the 1940s; it was patented several decades earlier. It had been employed by telephone companies in frequency-division multiplexing, a way to transmit several calls on a line at the same time. SSB transmission involved creating phase shifted audio signals, balanced modulators to create phase shifted RF and cancel the carrier, combining the audio, and cancelling one of the sidebands. This circuitry was followed by several stages of RF amplification to produce a linear SSB signal on the air. One thing that intrigued some hams was the possibility of generating the SSB signal at a high level, essentially transmitting the output of the balanced modulators. The cover shows a partial schematic that I produced from the *Radio Handbook* of their successful design. Four phased audio signals directly drive the grids of four 813 power triodes, accomplishing SSB generation directly at the kilowatt level, and feed it to the antenna (through an LC network, of course). That was ingenious! The book had a construction article using the technique, replacing the 813s with 807s. 1949 state of the art? Looks like it to me.

I've discussed the more recent past a bit here. But what's that device on the cover that is aligned with "2008"? I saw it at FDIM this spring in the Homebrew Competition/Show and Tell, and I had the opportunity to speak with one of the designer/builders about it. The interesting piece of equipment is the High Performance Software Defined Radio transceiver, and the person I spoke with is none other than Phil Harman, VK6APH. The HPSDR project, for which Phil is obviously a major contributor, is an open source, GNU-type collaboration of hams all over the world. The three boards and the base (backplane) that they are plugged into are only the beginning of a development process that includes many other complementary modules. It currently works with a PC and a sound card; however, one of the modules under development is a DSP back end that will allow operation without being attached to a PC. The HPSDR design is highly configurable for specific applications. Phil made the first contact with the HPSDR as shown last fall. I mentioned DDS earlier as a significant modern technology. DDS is used in the HPSDR used to produce the "RF half" of a phasing system. The "audio half" is performed mathematically in the PCRF section.

The ingenuity of ham radio operators never ceases to amaze. Phasing, a technology that provided the major impetus to develop a more efficient mode of voice communication, SSB vs. AM, was never allowed to die. Complementary technologies of the digital age have allowed inspired hams to develop new ways to achieve the successes of what had been a revolution back in the 1950s and '60s.

I'd like to thank Phil Harmon, who wrote the article and presented it at FDIM. I'd also like to thank Lyle Johnson, KK7P, who answered my questions about the HPDSR and the employment of phasing in the design. For more information on the HPSDR project, visit http://www.hpsdr.org.

—72 de Ted, KX4OM

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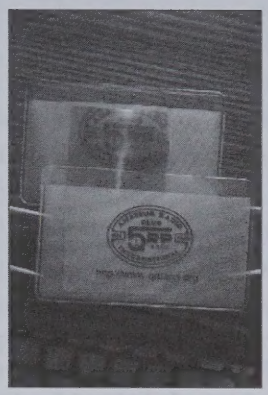

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Idea Exchange

Technical Tidbits for the QRPer

Mike Czuhajewsi—WA8MCQ wa8mcq@verizon.net

In this edition of the Idea Exchange:

Antenna Analyzer as a Precision "Dip Meter," N2CX
TenTec Knob Repair, K9EW
WM2 Wattmeter RF Activated Switch, VE3FAO
Bottom Insulator for Altoids Tins, N1RX
Add Reach to the AADE LC Meter, K3NHI
Different Readings with the Extension Probe, 4Z4ME
Dust Cover for the Tuna Tin II, N4TRB
Starter for Small Nuts, K3NHI
DeOxit Contact Cleaner, KX4OM

New WA8MCQ e-mail address! I have recently changed Internet providers. Readers should reach me at my new address: *wa8mcq@verizon.net*.

Antenna Analyzer as a Precision "Dip Meter"

Joe Everhart, N2CX, presents #67 in the endless string of Quickies he promised me back in the early '90s—

Many of us "greybeards" who became radio amateurs back before semiconductors were ubiquitous relied heavily on grip dip meters for checking and aligning our radio gear by easily finding resonant frequencies of tuned circuits. Back then, inductors were often large air core structures and were used in high impedance vacuum tube circuits. Grid dippers used a tube oscillator with plug-in coils whose grid bias current was metered. The dipper was held close to a coil in a resonant circuit. When the external circuit was resonant it "sucked" energy from the dipper, resulting in a dip in the grid current. It was a quick, easy way to get an approximate idea of the tuning frequency of LC circuits. In time other dip meters were designed using either transistors or tunnel diodes but they all operated on the principle that a coupled resonant circuit will extract energy from an oscillator and that loss of signal can be detected.

Several trends in circuit design lessened the utility of grid dippers. One of them is that large air-core inductors became less common, at least in low power circuits. The iron cored solenoids or, even worse, toroids, were more difficult to couple a dipper to even when they were not buried in a nest of printed circuit cards. Secondly, the low impedance of solid state circuits, particularly when powered off, resulted in very low operating Q in resonant circuits, making the resonance indication of a dipper much more difficult to measure.

Another disadvantage of most dip meters is that they are not too accurate. They usually have a wide tuning range and thus only approximate dial readings. Further, since they interact with the resonant circuit being checked, meter tuning is "pulled" resulting in more frequency uncertainty. This lack of accuracy limits dippers to only approximate results when measuring high Q tuned circuits and narrowband antennas like mobile whips and magnetic loops.

There are other means to measure these high Q devices using instruments called antenna analyzers, available from MFJ, Autek, AmQRP and Palstar among others.

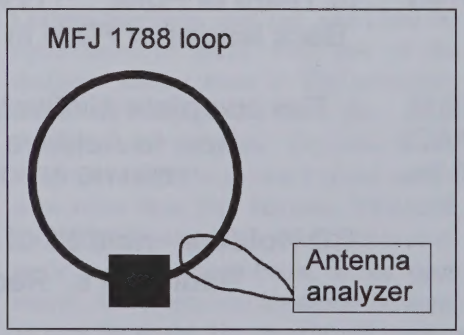

Figure 1—Antenna analyzer "dipper" setup.

The most straightforward way of using these devices is to physically connect them to the circuit or device being measured. This is fine although not as handy as proximity coupling for a fast check using the older dip meters. However, there is a way of using an antenna analyzer to do basically the same job while getting a very precise resonant frequency indication.

Doing this is very simple. All you have to do is couple a single turn of wire around the tuned circuit inductor. This is mentioned in passing in MFJ and Autek Antenna Analyzer manuals, as a kind of afterthought. The actual details are left to the equipment user's imagination when actually it is a very powerful measurement technique. It relies on the fact that a short (1 to 3 feet) piece of wire has a resistance of less than an ohm and a very low reactance in the HF spectrum. However, when it is coupled to a tuned circuit the reactance and resistance rise dramatically at the circuit's resonant frequency. So if you observe the reactance and resistance as the tuned circuit or analyzer is tuned, you will be able to easily see this effect. Since the instruction manuals are mum on the actual values to look for, this Quickie will give an example to show detailed information on what to expect with a typical setup.

Figure 1 shows the setup for measuring a magnetic loop. The loop used is an MFJ-1788 that is specified to tune over the range of 40 to 15 meters. A two foot piece of insulated hookup wire is placed around the loop and connected to the analyzers test terminals. A BNC to 5 way binding post adaptor was used with the AA908 antenna analyzer. The hookup wire coupling loop needs to be spaced symmetrically from the magnetic loop and physically stabilized so that it does not move around, otherwise it will erratically detune the loop being tested.

An AA908 was used since it was on hand, though others can be employed as well. By word of caution, though, an analyzer with a direct digital synthesizer such as the AA908 or Palstar ZM-30 is easiest to use for narrowband antennas due to their

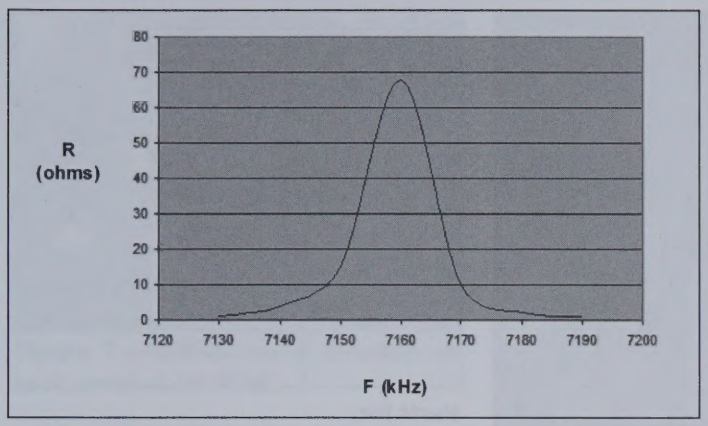

Figure 2—R vs. F (wide view).

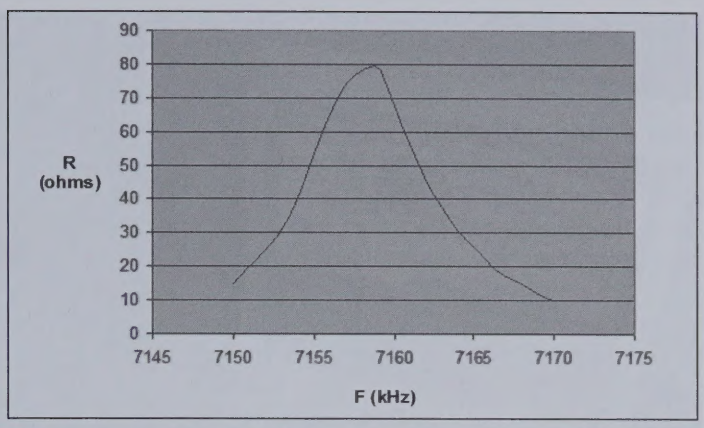

Figure 3—R vs. F (close in).

F (kHz)	R (ohms)
7130	1
7140	4
7150	15
7160	68
7170	10
7180	2
7190	1

Table 1—Measured Data

superior frequency resolution and stability. A second choice might be one of the Autek analyzers with their fine tuning ability. While the MFJ analyzers can be used, their stability and wide tuning range make them touchier to tune.

To check out the technique I tuned the MFJ loop to peak the received foreign broadcast signal in the middle of the 40 meter band without knowing the exact signal frequency. Then I disconnected the coax feedline from the loop and connected the coupling loop and analyzer as shown in Figure 1. Knowing the loop was tuned somewhere in the middle of the 40 meter band (yes it was kinda cheating but only to speed up the data taking for this Quickie) I tuned the analyzer from 7000 to 7300 kHz in 10 kHz steps while noting the RF resistance. Below 7130 kHz and above 7190 kHz it was 1 ohm or lower as expected. Table I shows that it rose rapidly above 7140 and peaked sharply at 7160 kHz. The same data is shown in a more visual means in the graph of Figure 2.

Having established that the loop seemed to be resonant at about 7160 kHz, another sweep was done in 1 kHz steps between 7150 and 7170 kHz. The numerical data is not very interesting, although when plotted as in Figure 3 the resonance is evident at just about 7160 kHz. Naturally, in use it is not important to record or plot out the data, only the peak resonant point.

I hope that this Quickie has shown that this "dip meter" method is easy to set up and use and will provide a fast, simple, very accurate way to modernize the old reliable grid dip oscillator technique.

—DE N2CX

TenTec Knob Repair

This useful idea comes from the web page of Ed Worst, K9EW (http://www.k9ew.us)—

TenTec makes some mighty fine equipment, but their knobs leave a lot to be desired. It's possible to crack the plastic knobs if you over-tighten the setscrew. And—for a knob that goes onto a bandswitch—it's hard not to over-tighten it. This situation is what lead to my looking into repairing, rather than replacing, the knobs.

I researched the shelves of the local hardware, automotive, and grocery stores looking for a good adhesive to use for this repair. I'm sure there are many others that are suitable, but when I saw that JB Weld epoxy was used to repair a tractor engine, well, that ended my search.

The repair process is simple. Mix up some JB Weld; you don't need much, but don't be stingy because the larger the glob of filler, the easier it is to get an equal part of the hardener.

You want to get that epoxy into the "moat" between the inner and outer rings of the knob. I used a flat toothpick and a resistor lead to do this step. A syringe would be great, but I had to settle for the "low-tech" tools.

Clean off any epoxy that isn't where it's supposed to be, and let it cure. Give it 24 hours to be safe. Then put the knob back on the rig, and you're in business. My repairs have lasted since mid-2006 without failure, so I think it's a pretty good solution.

—DE K9EW

WA8MCQ comments—JB Weld is a company that makes a variety of epoxy products, and is also the name of their flagship product. It's marketed as a cold welding compound and is a filled, high temperature epoxy. (The MSDS indicates that it contains 10 to 20% by weight of iron powder, although they say that it does not conduct electricity.) They say that it can withstand up to 500 degrees Fahrenheit continuously and up to 600 degrees for 10 minutes. You can find more info on their web site, www.jbweld.net, and you should be able to find the product in hardware and automotive stores everywhere in the US. (It's also marketed in several other countries.)

WM2 Wattmeter RF Activated Switch

From Frank Roberts, VE3FAO (ve3fao@rac.ca)—

The Oak Hills Research WM2 QRP Wattmeter kit (Fig. 4) is an excellent instrument. I have mine connected permanently and use it every time I'm on the air. The only problem is that I occasionally forget to turn it off and the 9 volt battery dies prematurely. There have been articles about adding an LED to the unit, but I didn't want to put holes in the case or add to the power drawn by the meter. I decided to

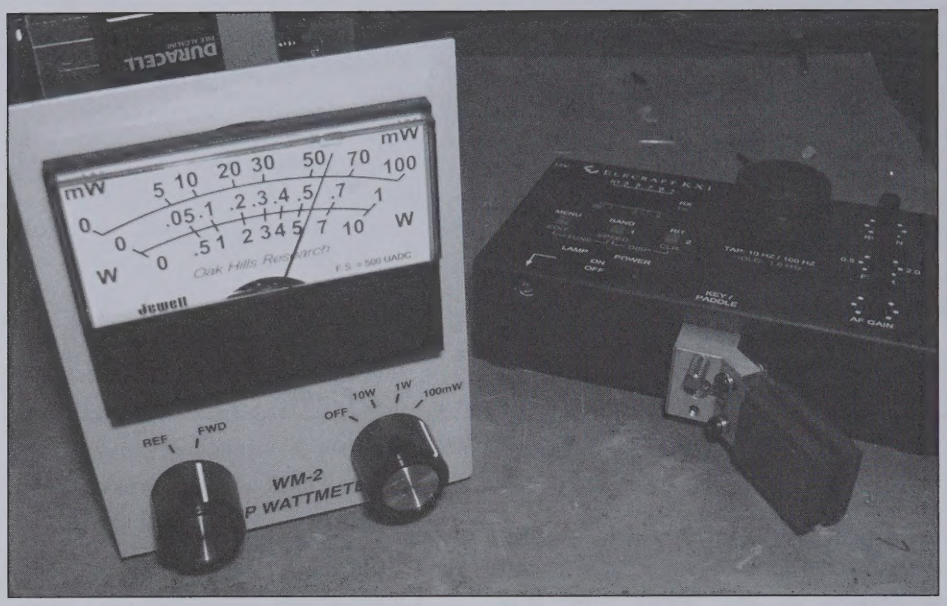

Figure 4—The OHR WM2 QRP wattmeter.

C1, C3	0.001 µF
C2	0.05 µF
R1	15K
R2	150K
R3	4.7M
D1	1N34
Q1	VN10LP, N-channel insulated gate FET
Q2	2N3906

Parts list.

adapt an RF activated power switch circuit designed by Joe Everhart, N2CX, along with a standard RF probe and apply it to the WM2 wattmeter.

The result was a modification (Fig. 5) that mounts on the inside of the back cover. When the unit is left on, but in standby mode, only 4 micro amps are being drawn from the battery. This modification should work with any QRP wattmeter or other RF activated devices.

The circuit was built in Manhattan Style on a 1 × 2 inch piece of PCB material, with a suggested layout shown in Figure 6. This size board will fit on the inside of the back cover between switch S3 (Internal/External Power Switch) and the RF input jack J1, as seen in Figure 7. You can affix the board to the case with hook and loop material, glue or even double sided carpet tape.

To connect the completed board, first identify the wire coming from the battery's positive side to terminal 1 of S3. On my unit this was a brown lead. Cut this lead so that the end coming from the battery will reach the pad in the top right of the new circuit board and connect it. The other part of the lead coming from S3 should be soldered to the pad at the top center of the board. Connect a lead from J1 (RF IN) to the pad on the lower left of the board. Finally solder a wire from the ground plane of the circuit board to the ground lug on the rear cover adjacent to the lower right side of the board.

In battery mode it only takes less than 70 milliwatts to activate the circuit. I have found that there has been no adverse affect on the accuracy of the wattmeter after the modification has been installed.

—DE VE3FAO

Bottom Insulator for Altoids Tins

This neat idea comes from Bruce Beford, N1RX, posted to the Rock-Mite forum on yahoogroups.com—

There have been recent comments about being careful to prevent shorts to a metal case when mounting the Rock-Mite (or any other PC board for that matter). A free source of insulating material, already cut to size, shows up in our mailboxes constantly. It's those simulated plastic credit cards that come with the junk mail. Some are cardboard, but most are plastic. They are just the right size for putting in the bottom of an Altoids tin as an insulator beneath your board. I like the clear ones from American Express. The best part is the price.

—DE N1RX

WA8MCQ comments—Figure 8 shows an example, although I cheated a bit and used a debit card instead. The fit is perfect. (The clear American Express does look nice, although it doesn't show up as well in a photo.)

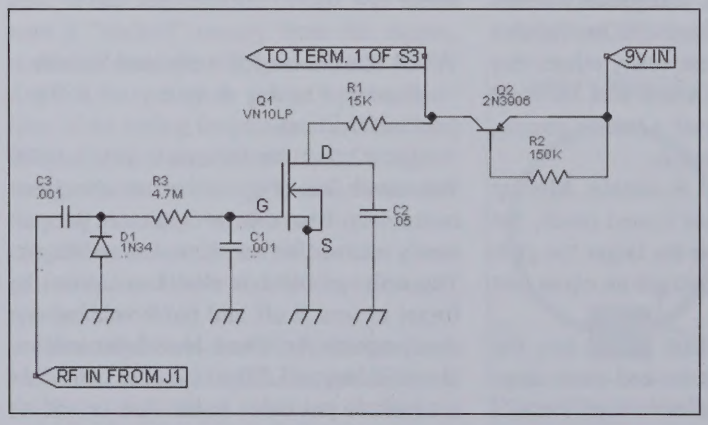

Figure 5—Modification schematic.

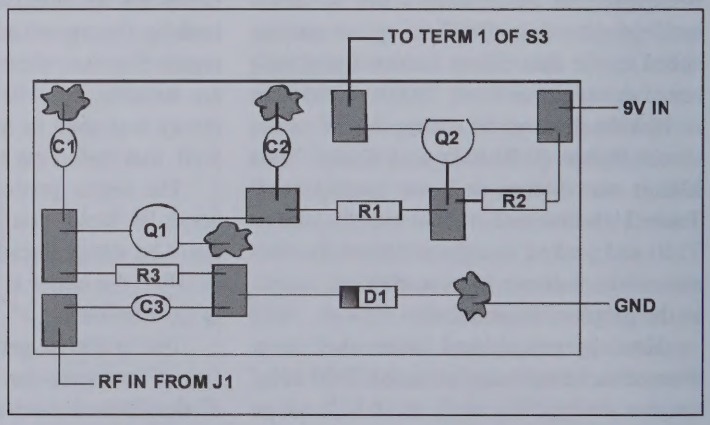

Figure 6—Suggested circuit layout in Manhattan style.

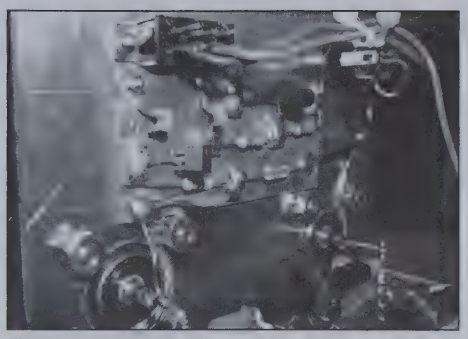

Figure 7—Circuit board installed on back panel of the WM2.

Figure 8—Credit card junk mail provides a free Altoids box insulator.

Add Reach to the AADE LC Meter

Bob Kopski, K3NHI, is a frequent contributor to the EMRFD discussion forum on yahoogroups.com. Here is one of his recent contributions—

I, as so many others, very much like the AADE LC meter. This is one great asset for any shack, especially the shack of a homebrewer. But often I wished for just a bit more - like being able to easily measure some "C" on a board or within some ugly construct. I wished for a probe extension for my AADE.

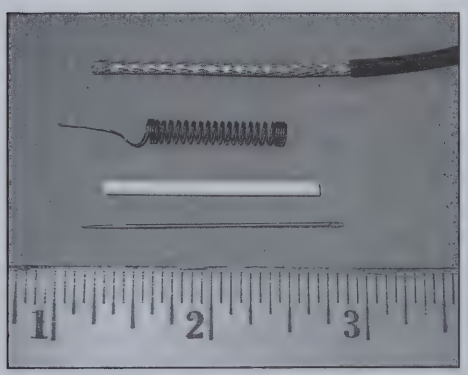

Figure 9—Most of the parts needed to duplicate the probe.

The photos here (which are also in the K3NHI folder in the Photos section of the EMRFD home page) illustrate one approach to such a probe. It's conceptually simple and in my case all parts and supplies already existed in my shop. (Some of these came from my aero modeling hobby and are typically found at hobby shops, or as below.)

Figure 9 shows much of the stuff that's needed. The basics include a sewing needle about 1 1/2" - 1 3/4" long, a plastic insulating tube to slip over the needle, a slightly un-wound spring liberated from a ball point pen, and a piece of RG-174 stripped about 2".

Probe assembly begins with dressing the cable braid back on itself, shortening the coax center conductor, and soldering the needle to the latter. What you see in Figure 10 is not a sloppy solder job. Rather, solder bumps placed along the needle length were intended to provide something for epoxy to hold on to when the insulating tubing was glued in place—but gluing turned out not to be needed—so no solder bumps are warranted!

This step is followed by sliding the plastic tube over the needle right up over some of the coax center conductor insulation (Fig. 11) and then dressing the coax shield back over the plastic tube (Fig. 12). The braid is trimmed back from the tube front end about 3/8". The last step in this sequence is to slide the modified spring over the dressed braid (Fig. 13). Some heat shrink tubing is placed as a "back stop" to prevent rearward travel of the spring. Do take particular note of the relative positions of the spring extension, needle, plastic tube, and the final braid position.

One more note: the spring inner diameter should permit easy installation over the re-dressed braid. The spring must still be a little compressible but not so large in inner diameter to permit poor or intermittent contact with the braid - this is the "ground" contact of the finished probe. There is a lot of braid / spring overlap, and so adequate contact should be assured with a reasonable sliding—not sloppy—fit of the spring-on-braid.

As I found out, it is possible to accidentally pull out the ground probe/spring from the assembled unit and it does not go back in place without disassembly. During rework, after redressing (smoothing) the braid and maneuvering the spring back in place, I looked for ways to keep it there. I considered a small smear of hot glue over the spring and braid, near the base end of the spring, or a simple binding of one or two loops of thin thread (maybe dental floss) falling between spring coils, against the braid. The idea is to hold the spring in place and maintain good contact with the braid.

Finally, a loose fitting plastic tubing / handle is slid over the whole works (seen in Fig. 14). Mine is 3" long and I used

Figure 10—Beginning step in the probe assembly.

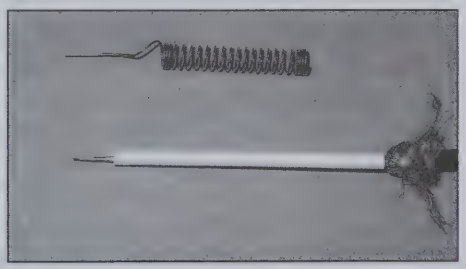

Figure 11—Plastic overcover for the probe needle in place.

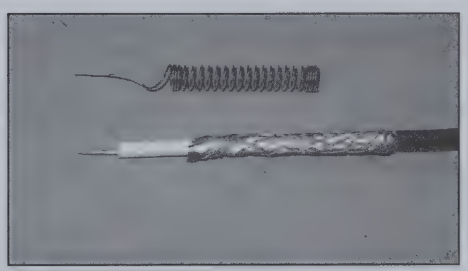

Figure 12—Re-dress the coax braid over the needle's plastic cover.

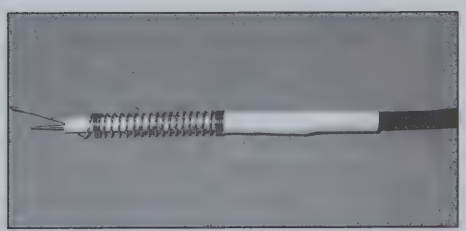

Figure 13—Slide the probe spring in place, noting relative position of all parts.

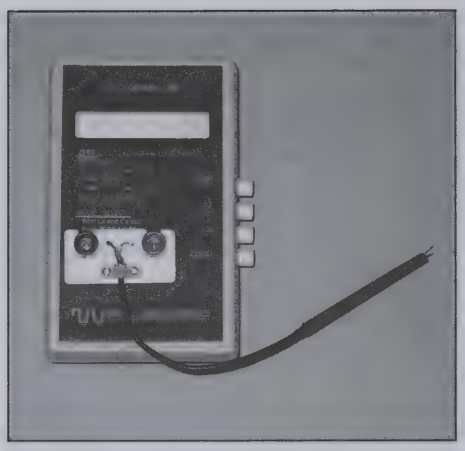

Figure 14—AADE LC meter with completed homebrew probe extension.

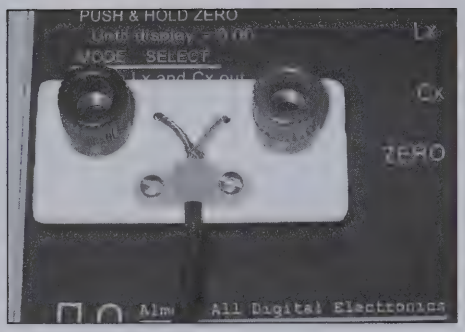

Figure 15—Front side of the adapter used to connect the probe to the meter.

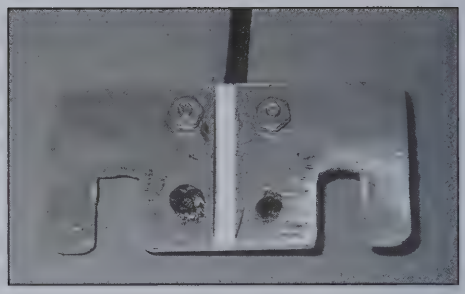

Figure 16—Rear of the adapter.

some hot glue to adhere this tube to the coax outer cover at the rear of the tube - which keeps everything together.

Figures 15 and 16 show the front and rear of the adapter at the end of the cable which connects to the meter. (A piece of single sided PCB material was used, although double sided can also be used if you cut a slot down the middle on both sides.)

The bent-out extension of the spring—the ground contact—is quite slinky in a firm kind of way and easily moves some within the handle. It is even compressible back even with the needle tip. The needle tip is the "hot" end of the probe and of course is the other contact point. It is normally about 3/16" behind the ground contact.

In use, the ground contact is placed as appropriate and the needle tip is maneuvered into contact as needed. In effect, the ground contact is used as sort of a pivot point while the needle tip is being aimed. A more-vertically held probe seems to give better repeatability than a lower angled approach to the target component. I'm guessing this has to do with the few front spring coils that are not in contact with the coax braid. Anyway, this is easier to do than to describe.

My RG-174 is approximately 8" long, and the entire probe assembly indicates about 22 pF—which is then zeroed-out on the AADE. This probe typically indicates capacitance a fraction of a percent higher than the same capacitor placed in the meter terminals. I did learn that a longer cable tends to slightly increase this difference, although I'm not sure why.

Because there are several physical variables, such as exactly what a retrieved ball pen spring may measure, or what plastic tubes are handy, etc., I've avoided detail dimensions. And while my "inner" and "outer" tubes were hobby shop supplies, I can also imagine using the spray spout tube from an aerosol can, and a ball pen, or plastic pencil for the respective tubes. There are probably numerous other choices I've not thought of. Just pay attention to the relative positioning of the various parts as in the photos, and all should be well. I believe you will find the added reach of your AADE well worth this easy assembly chore!

—DE K3NHI

WA8MCQ notes—The EMRFD forum on Yahoogroups.com was started in July 2006 by Roger Hayward, KA7EXM. The description statement of the group says that it is a "Gathering place to discuss experiments, projects, improvements, etc., and technology in the same vein as that found in the ARRL publication *Experimental Methods in Radio Frequency Design*." (All three authors of the book contribute from time to time.)

Info on the LC meter (and a lot of other things) can be found on the AADE web site at http://www.aade.com. The device has been around since 1996 and several thousand have been sold. (He also has some good filter software available. I thought it well worth the price when I paid for it, but it's been available as a free download for several years now.)

Different Readings with the Extension Probe

Victor Koren, 4Z4ME, subsequently posted this explanation of the slightly different capacitance readings when using an extension probe on the AADE LC meter—

My explanation of the capacitance reading of the meter when using a long coax as probe is simple:

The coax is a transmission line and, being so, it is not just an added parallel capacitor because it has distributed series inductance with distributed parallel capacitance. For very short pieces of transmission line it is approximated well as parallel capacitance but as it gets longer the series inductance can't be ignored. The easiest way to see how the coax affects the capacitor measurement is by using the Smith chart.

A capacitor at a specific frequency will have a negative reactance which will be located at a point on the bottom perimeter of the Smith chart. Connecting a short coax in series with the capacitor will move the reactance to the left, still on the Smith chart perimeter. The new point is a lower reactance point which means higher input capacitance. Making the coax even longer will move the input impedance towards the left end of the chart which represents zero impedance or in other words infinite capacitance. No real capacitor added in parallel to the measured capacitor could have done that, so the conclusion is that a transmission line increases the input impedance seen by the AADE meter more than just its parallel capacitance.

—DE 4Z4ME

Dust Cover for the Tuna Tin II

Or, as he calls it, the "Tuna Tin II Topper," Brian Page, N4TRB sent this along—

Toroidal inductors are beautiful. One of the things I like best about my Tuna Tin II rig is that all the components, especially the brightly-colored toroids wound with equally brightly-colored enamel wire, are exposed for all to admire. And now, thanks to Charlie the Tuna, I have the perfect custom fitted dust cover for the little rig, as

Figure 17—A dust cover for the Tuna Tin II.

shown in Figure 17.

StarKist makes a product called "Charlie's Lunch Kit Tuna Salad" that contains everything one needs to make a one-serving tuna salad. The kit includes tuna, crackers, mayonnaise, relish, a little spoon and, most importantly for the QRP crowd, two plastic containers for mixing said ingredients. Fortunately, the lower portion of the fitted plastic container is exactly sized to mate with a regulation diameter tuna can. So mix your salad, eat your lunch, zip the container through the wash, and presto, you have a dust cover to keep those toroids shining brightly.

—DE N4TRB

Starter for Small Nuts

While we were swapping e-mails, Bob Kopski, K3NHI passed this along—

I have recently found a source for the plastic nut driver tool commonly supplied with Heathkits in decades past. I love this tool; my ancient ones were well worn and I made a lucky search. Try this:

http://www.stanleysupplyservices.com/product-group.aspx?id=1457

—DE K3NHI

WA8MCQ comments—Most of the old-timers probably remember the neat little plastic tools that Heath used to include for starting nuts, and this is pretty much the same thing. There's not much to it except a piece of thick plastic tubing with different diameter openings on the ends. You just push it down on a #2 to #6 nut and it holds onto it by friction. Now the nut has a handle on it and it's a lot easier to get it started, especially in a deep or inaccessible area. As the nut is tightened the tool slips off easily.

These are made by Menda, a name I recognized instantly from those little pump-top bottles filled with alcohol we have on our benches at work. (They are the originals, although others now make the bottles as well.) In addition to the link above you can also find them on the Menda site at www.mendapump.com. Search on part number 35120; their price is under $2 each.

If you're an old-timer, rejoice because you can still get these incredibly handy little tools. And if you have no idea what this is, trust me, it's one of those things you'll wonder how you ever lived without it when you finally get one.

DeOxit Contact Cleaner

This line of products has become fairly well known in recent years. Ted Bruce, KX4OM, shares his experience with it—

While restoring a Hallicrafters SX-140 tube receiver recently (1960s vintage), I noticed that I had what seemed to be intermittent static crashes on all bands, blocking out most of the signals. I found that when I tapped on the chassis with my hand, that would cause a very loud and extended crash in the speaker. Investigating further, it would occur when I touched any of the receiver's tubes. I thought, "Aha! Maybe the pins or the tube sockets have some type of corrosion or deposits on them."

I had recently bought some Caig Laboratories DeOxit electronics cleaning products, and one of them was a 100% solution of DeOxIT5, in a small polyethylene squeeze bottle. I thought I'd try that on the tube pins, all of which were 7 or 9-pin miniature types. I inserted the pins one at a time in the top of the neck of the bottle, and I squeezed until I saw the red chemical flow up around the pin. After treating all of the pins of a tube, I inserted it into its socket, and pulled it out again, to attempt to rub the solution on the inside of the socket pins as well. The receiver was off and unplugged, by the way. Yeah, there is probably a quicker way to do that, but rather than search for my chamois swabs, I just went ahead and did all the tubes and their pins.

After all tubes were done, I fired up the receiver. No noise yet. Then, as a positive check, I put my finger on the top of the audio amplifier tube, and moved it in a circular motion…no noise! I did the same to each of the other tubes with the same result. Problem solved! For hollow state homebrewers of transmitters, receivers, VHF converters or whatever, this may be of use if you are using old tubes, or if the sockets are old, as well.

—DE KX4OM

The Fine Print

Do you have an idea or project you'd like to share with our readers? Or maybe something you saw on a web page somewhere, or perhaps even on your own? Whatever it is, send it along by e-mail or snail mail or even hand me a floppy or CD at a hamfest and I'll take care of it. I handle editing, drawing things up on the computer if needed, getting permission where appropriate, etc. And if you don't get a response, or do get one but don't see it in print after a couple of issues, be sure to let me know!

Remember! WA8MCQ e-mail is now: wa8mcq@verizon.net ●●

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Phasing Techniques in the Digital Age

Phil Harman—VK6APH

Receivers and transmitters based on phasing techniques have been long favorites of home brewers. Whilst analogue techniques produce equipment with modest performance, the latest digital techniques have revolutionized the performance of such designs. This paper explains in detail the theory and practice behind analogue and digital phasing techniques—and introduces the next generation of radios that will use these techniques.

Introduction

Transmitters and receivers based on phasing techniques were used extensively in the early days of the introduction of the Single Sideband (SSB) mode of transmission and reception, back in the 1960s. Such equipment was renowned for the high-quality of both its transmitted and received audio.

However, the analogue techniques available in those days meant that the performance of such equipment fell short of what was possible by using crystal filter techniques. For this reason, SSB using phasing equipment dropped from popularity and became of the domain of a handful of experimentally-minded radio amateurs.

In recent years, the application of digital electronics to phasing techniques has revitalised this technology, resulting in the design of a large number of high-performance and cost-effective receivers and transmitters. In fact, the vast majority of consumer communications equipment is now based on phasing techniques.

The next generation of amateur radio equipment will be based upon digital phasing techniques—in fact, equipment of this kind is already commercial available.

So how have these digital techniques changed the radio designer's view of phasing techniques, and how can we, as experimentally-minded radio amateurs, take advantage of this exciting technology trend?

Some background

Before looking at these new techniques, it is useful to review the original analogue phasing techniques and their strengths and weaknesses.

The basic building block of a phasing receiver is the Direct Conversion Receiver—see Figure 1. Here the input signal, f_{in}, is applied to a mixer, together with a local oscillator f_{lo}, and the output of the mixer applied to a Low Pass Filter (LPF).

The output from the LPF, which will be in the audio range, is then amplified in order to drive headphones or a loudspeaker. The selectivity of the receiver is determined by the characteristics of the LPF and its sensitivity by the performance of the mixer and that of the amplifier which follows the mixer.

The main advantage of the direct conversion receiver is simplicity! The complete receiver consists of just three major components—a mixer, low pass filter and amplifier.

In practice, some form of input filtering is needed between the antenna and the receiver and, depending on the type of mixer, perhaps a RF pre-amplifier. However, for now, this simple model is sufficient to illustrate the relevant principles.

Notice that no values have been given for f_{in} or f_{lo} as yet. In fact, these frequencies can be anywhere from a few tens of kilohertz right up into the microwave region. Assuming an appropriate mixer is chosen, then the block diagram, performance and operation of the receiver remain much the same, independent of frequency.

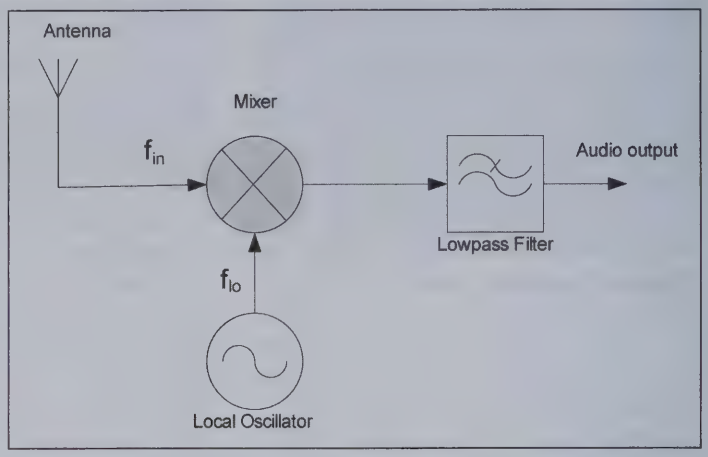

Figure 1—Direct conversion receiver.

For all its simplicity there are a number of short comings of the direct conversion receiver. Whilst these can be mostly overcome by using good construction techniques, there is one drawback that is very significant when the receiver is used for amateur radio communications—let us specifically consider this.

Assuming an ideal mixer, the output of the direct conversion receiver will consist of two frequencies, namely:

$$f_{in} + f_{lo} \quad \text{and} \quad f_{in} - f_{lo}$$

Let's fill in the figures for the above equation, using, say, some for a 14 MHz CW receiver. If our wanted signal is at, say, 14.050 MHz and our preferred beat note is 1 kHz, then the local oscillator can be set to:

14,050,000 + 1,000 = 14.051 MHz

So far, so good! But look what happens if there happens to be another CW signal at 14.052 MHz. In this case, we get:

14.052 – 14.051 = 1 kHz

What this means in practice is that we get to receive both CW signals simultaneously. This problem of receiving an unwanted signal on the other side of the local oscillator frequency is called an image response. We will see shortly how phasing techniques can be used to eliminate responses of this kind.

I mentioned earlier that there were other shortcomings of the simple direct conversion receiver. These include:

- Radiation of the local oscillator signal from the antenna socket and the receiver's antenna

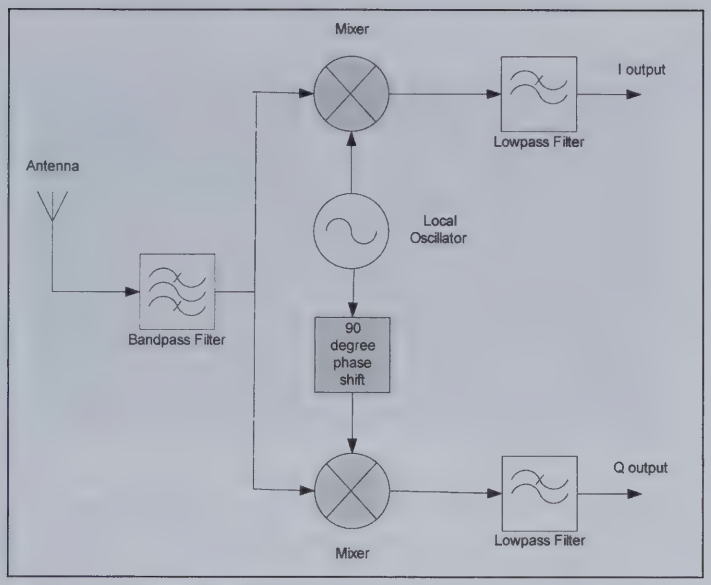

Figure 2—Basic phasing receiver.

- Modulation of incoming signals by hum coming from the AC mains supply.
- Instability due to the high level of gain required at audio frequencies for the receiver.
- Signals from high-power Medium Wave broadcast stations appearing in the receiver's audio output
- The tuning and performance of the receiver being affected by "hand capacitance" effects, when the receiver is touched or tuned.

Again, all these issues can be addressed by applying sound construction techniques. For example, the Heathkit HW-7/8/9 range of low-power transceivers which used a direct conversion receiver managed to generate a substantial following amongst radio amateurs during the 1970s and early 1980s.

Removing the image

To remove the image reception problem from a direct conversion receiver, it is necessary to add some additional components to our original block diagram. If you look at Figure 2, you can see an identical second mixer has been added, along with a 90-degree phase shift to the local oscillator and a second, duplicate LPF.

Why would we go to the trouble and expense to provide two identical audio outputs? These two output signals are the same—right? Well, not quite—there is an important difference between them. If you look closely at Figure 2, you will see that the local oscillator connection to the second mixer is passed through a block that is marked "90-degree phase shift."

This means that whilst the frequency of the local oscillator fed to the second mixer is exactly the same as that fed to the first mixer, the phase has been shifted by 90 degrees. This 90-degree phase shift will also be present on any signal that passes through the mixer, hence the audio output signal from the second mixer will be at 90 degrees to that produced by the first mixer. If a dual channel oscilloscope is connected to the output of the two audio amplifiers, the trace seen will resemble that depicted in Figure 3a.

The two audio signals are said to be in quadrature—or "phase quadrature"—and are labelled "I" (for in-phase) and "Q" (for quadrature). You will also see this I and Q signal pair referred to in some texts as a complex signal (though hopefully not complicated after the preceding explanation!).

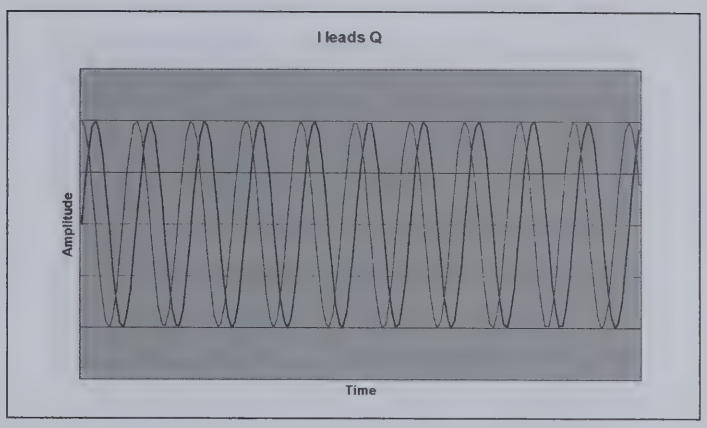

Figure 3a—I and Q audio sine waves, showing 90° shift.

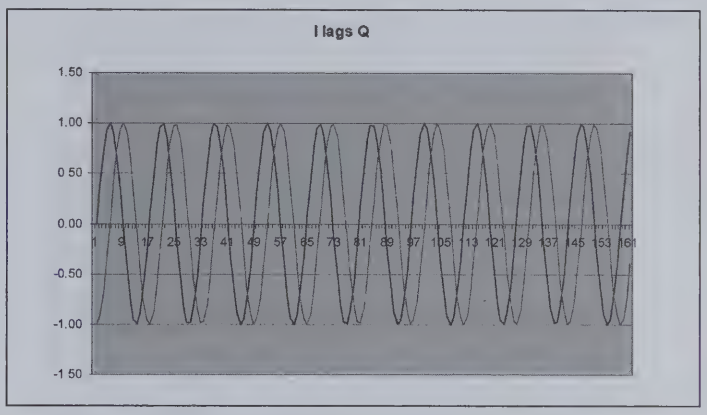

Figure 3b—I and Q audio signals for the image frequency.

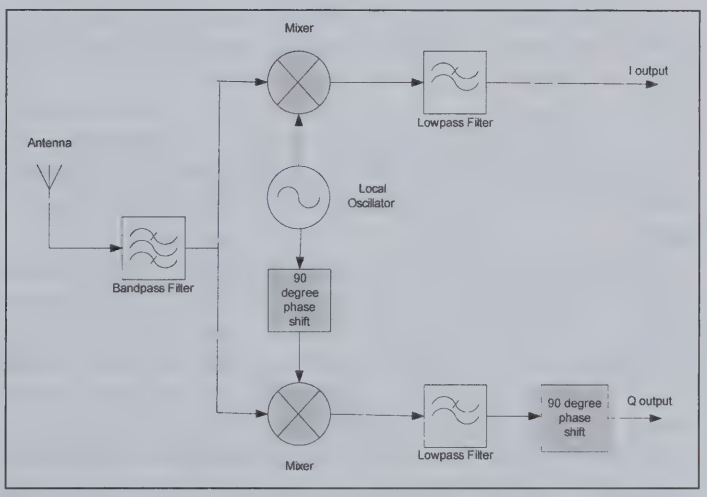

Figure 4—I and Q receiver with lowpass audio filters.

So back to our original question: "Why go to all the trouble and expense to generate two signals 90-degrees out of phase with each other?"

Someone once said "give me I & Q and I can demodulate anything" [1]. And that, quite literally, is the reason we go to all this

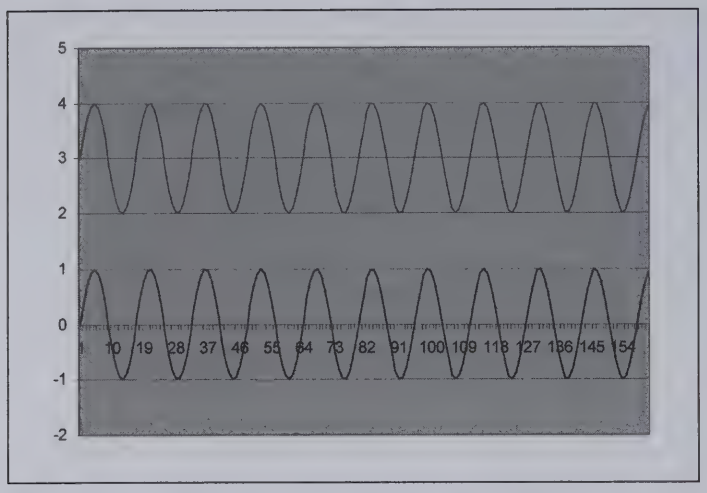

Figure 5a—I and Q relationship for the wanted signal.

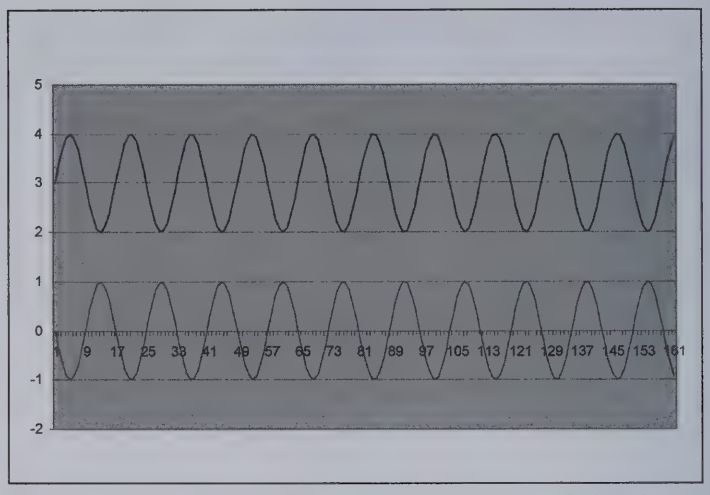

Figure 5b—I and Q relationship for the unwanted signal.

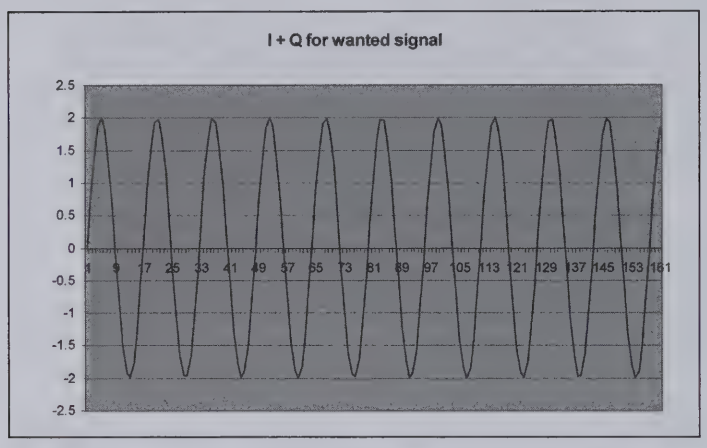

Figure 6a—Result of adding I and Q for wanted signal.

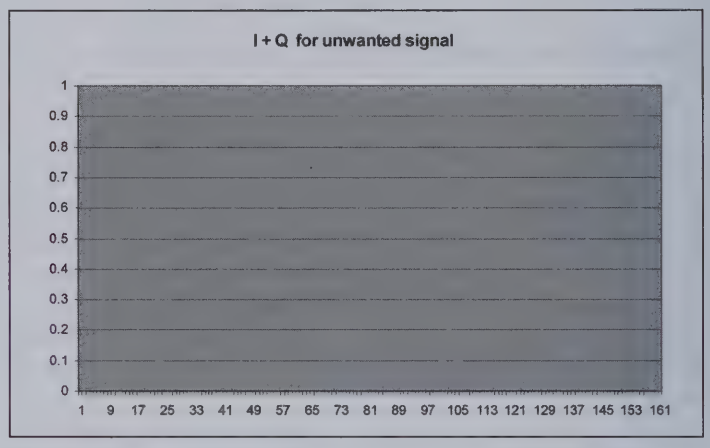

Figure 6b—Result of adding I and Q for unwanted signal.

trouble. If you have I and Q signals then you can demodulate any signal, be it AM, FM, SSB, CW, PSK31 etc, along with any modulation system that some clever soul may care to think up in the future.

Similarly, in the case of a transmitter, if the appropriate I & Q signals can be generated, any form of modulation can be transmitted.

We will look at demodulating other signals a little later, but for now let's concentrate on the removal of the unwanted image response from our direct conversion receiver.

In order to do this, an additional 90-degree phase shift needs to be added to either the I or Q signal and the two signals then added together. This is illustrated in Figure 4.

Let's again choose some actual frequencies to illustrate how this works. If it is assumed that the wanted CW signal is at 14.101 MHz and we would like to listen to a 1 kHz beat note, then the local oscillator could be tuned to 14.100 MHz, since:

14.101 MHz - 14.100 MHz = 1 kHz

However, if there is an additional, unwanted CW signal at 14.099 MHz, then this also produces a 1 kHz beat note, since:

14.100 MHz - 14.099 MHz = 1 kHz

If we look at the I and Q waveforms that result from applying a 14.101 MHz signal to the receiver shown in Figure 2, two 1 kHz sine waves with 90 degrees phase difference can be seen—see Figure 3a. Note that the Q signal leads the I signal in time.

If a 14.099 MHz signal is fed into the receiver shown in Figure 2, again we see two 1 kHz sine waves with 90-degrees phase difference but note that the Q signal now lags the I signal in time, i.e. the phase of the Q signal has been shifted by 180 degrees—see Figure 3b. It is this phase shift that enables us to remove the unwanted signal, as follows.

In Figure 4, the I and Q signals have been passed to two LPFs. Each LPF has the same frequency response, but the phase of all signals passing through the "Q" LPF are shifted by 90 degrees. Figure 5a shows the resulting I and Q signals for the wanted 14.101 MHz signal, and Fig 5b the resulting I and Q signals for the unwanted 14.099 MHz signal.

If the I and Q signals are now added together, the result is a signal of double the amplitude of I or Q in the case of the wanted signal (see Figure 6a), and zero in the case of the unwanted signal (see Figure 6b).

The end result is that we have produced a direct conversion receiver that responds to signals above the local oscillator frequency (i.e. Upper Sideband) and rejects those below (i.e. Lower Sideband). If instead of adding the I and Q signals together, they

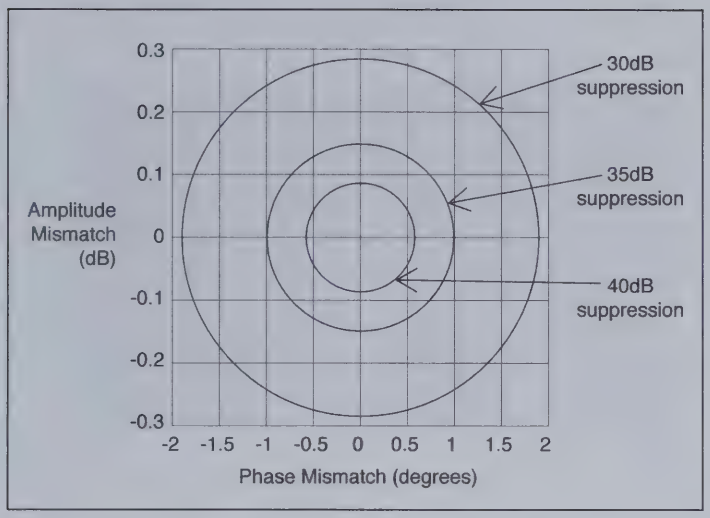

Figure 7. Suppression vs. amplitude and phase mismatch.

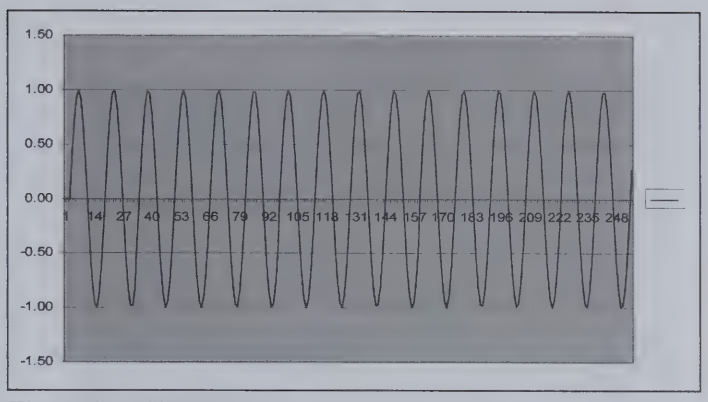

Figure 8a—Sine wave.

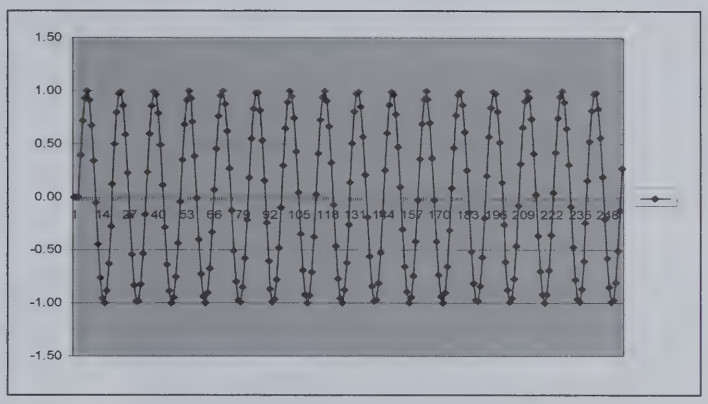

Figure 8a—Sampled sine wave.

are subtracted, them then the reverse applies.

All done?

So, have we totally solved the image problem with our direct conversion receiver? Well, if perfect 90 degree phase shifters are used for the local oscillator and across the entire bandwidth of the LPF, then "yes"—we get infinite image rejection. Unfortunately, at least in an analogue world, this perfection of phase shift is very difficult to achieve, so we end up with imperfect image rejection.

The level of image rejection achieved is dependent on two factors:

1. How close to 90-degrees we shift the phases; and
2. How close in amplitude we match the I and Q signals

And by close, I mean really close! The diagram in Figure 7 shows how close we need to be in order to achiever a high degree of image rejection. This situation is further illustrated in Table 1.

These accuracies need to be maintained over the full RF coverage of the receiver, e.g. zero to 30 MHz and AF bandwidth, e.g. 300 Hz to 3 kHz. They must also not vary with temperature, vibration, age, etc.

Given the analogue techniques that were available in the early days of SSB, it's not surprising that the advent of the mechanical and crystal filters, which could provide over 90 dB of image rejection, sounded the death knell for phasing receivers!

However, the advent of digital techniques means that now we can build phasing-based receivers and transmitters that have image rejections that equal the very best filter-based designs. To use such techniques, the RF signals need to be moved into the digital world, so let's see how that is done.

Digital signals

Most radio amateurs that have a personal computer will be familiar with its sound card. Analogue devices, such as a microphone, can be attached to these sound cards, their signals processed within the PC and then feed them back to another analogue device, e.g. a speaker or headphones.

What the sound card does is to perform an Analogue to Digital Conversion (ADC) and Digital to Analogue Conversion (DAC). Rather than processing a continuous signal, such as a sine wave (see Figure 8a), the ADC samples the signal at regular time intervals and records the instantaneous value at each sample time (see Figure 8b). The PC then processes these samples and feeds them back to the sound card, where the DAC turns the samples back into an analogue signal.

In order to undertake this ADC to DAC without loosing any of the original analogue information, it is necessary to sample the input signal at least as fast as twice the highest frequency contained in the analogue signal. So, for example, if it is desired to use an ADC on a speech signal that has a maximum frequency of 3 kHz, then it is necessary to sample it faster than 6 kHz.

There are a number of international standard sampling frequencies (often called "sampling rates") that apply to audio signals that are digitally sampled. For example, Compact Disc audio is sampled at 44.1 kHz, while PC sound cards may additionally support 48, 96 and 192 kHz sampling.

For RF signals, the previous rule applies—if it is desired to digitise a 30 MHz signal, then it must be sampled at a rate greater than 60 MHz.

PC sound cards are a very simple and relatively low-cost way of moving analogue signals into a PC for processing, so let's look at a popular way of doing this.

PC-Based Radios

We are now moving into the realm of Software Defined Radios (SDR). An SDR is a radio where the demodulation and

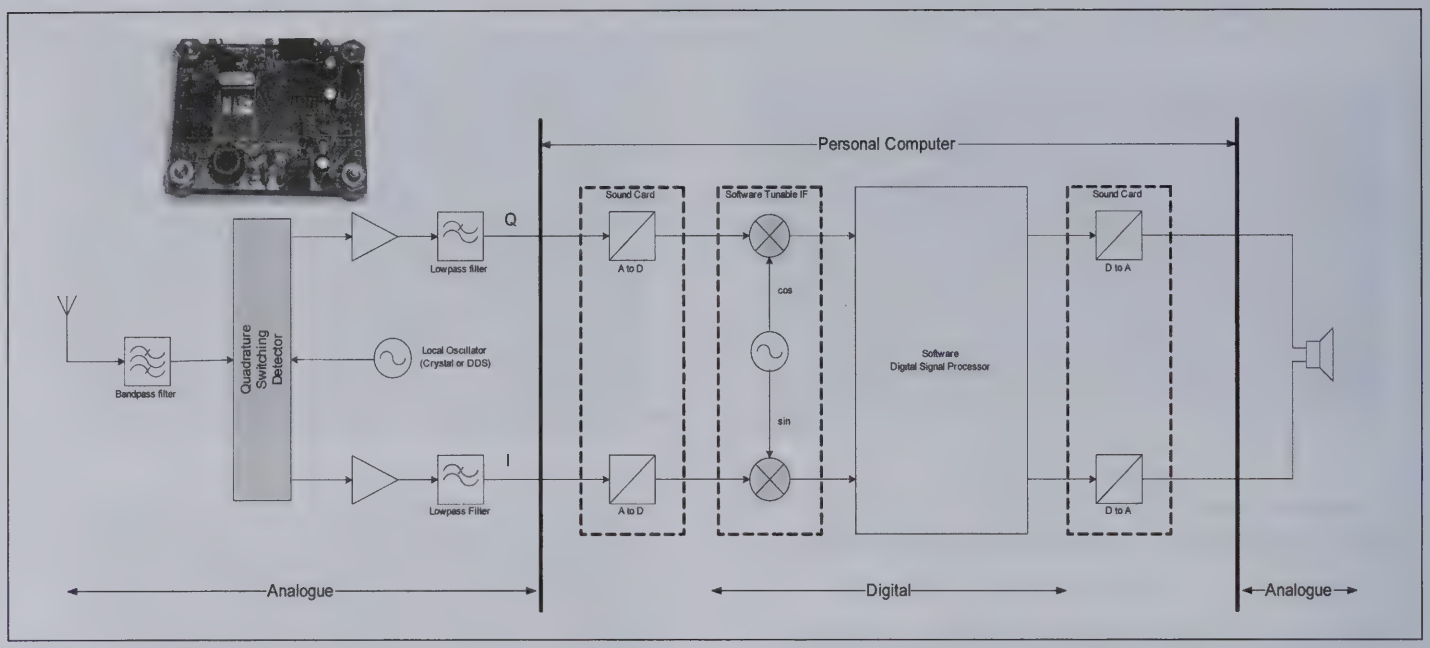

Figure 9—SoftRock phasing receiver.

modulation of signals is performed by software—in this case, running on a personal computer.

SDRs that use sound card technologies as analogue to digital converters include the low-cost SoftRock [1] range of receives and transceivers and the FlexRadio SDR1000 and Flex5000. Let's look at a SoftRock receiver and follow the transition from analogue to digital processing, Fig 9.

The I and Q outputs from the SoftRock receiver are fed to the stereo inputs of the PC sound card. The dual analogue-to-digital converter (ADC) within the sound card takes care of the conversion to samples, which are then processed by the desired software, e.g. PowerSDR [2], VE3NEA's Rocky [3] etc. After processing, the digital signals are fed back to the sound card, where a digital-to-converter (DAC) converts them back to into analogue audio.

So how does the SDR software process the I and Q signals and why does it do a better job than the equivalent analogue phasing receivers?

Digital Signal Processing

The processing of the digital signals within the PC is done using digital signal processing (DSP) techniques. Basically, the samples of the analogue signal are manipulated mathematically. With modern PCs, this manipulation can be done at very high speed and with great precision.

DSP-based signal processing has few of the problems associated with analogue processing. For example, DSP-based processing:

- Is not affected by temperature
- Is not affected by component tolerances
- Is not affected by component ageing
- Does not require component values to be 'tweaked'
- Is 100% reproducible
- Can deliver results that are impossible to produce using analogue components

So how is DSP applied to I and Q signals, in order to demodulate common modulation systems?

AM Demodulation

To demodulate AM, we simply use Pythagoras theorem and take the square root of the sum of I squared plus Q squared, as per Figure 10.

$$AM = \sqrt{(I^2 + Q^2)}$$

Each of the I and Q vectors will be varying in amplitude, in sympathy with the amplitude modulation on the incoming signal. Hence the hypotenuse of the triangle that we have just formed using Pythagoras will also vary in sympathy with the modulation.

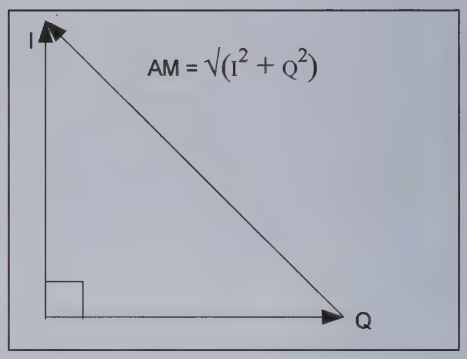

Figure 10—AM demodulation using I and Q.

This is really easy to do in software and the following is the actual line of code inside a module of code called am_demod.c (from the open-source PowerSDR code and contained within DttSP, see [2])

```
am->lock.curr = Cmag (CXBdata (am->ibuf, i));
```

At this stage, you may be thinking, "hang on a minute, if both I and Q are amplitude modulated in their own right, then why not just take one of these signals and measure its magnitude directly, since this would give us the original modulation back?" Note this is rather like using a diode to demodulate AM—just like we do in an analogue receiver.

The answer to your (very good) question is "yes." You could do as suggested,

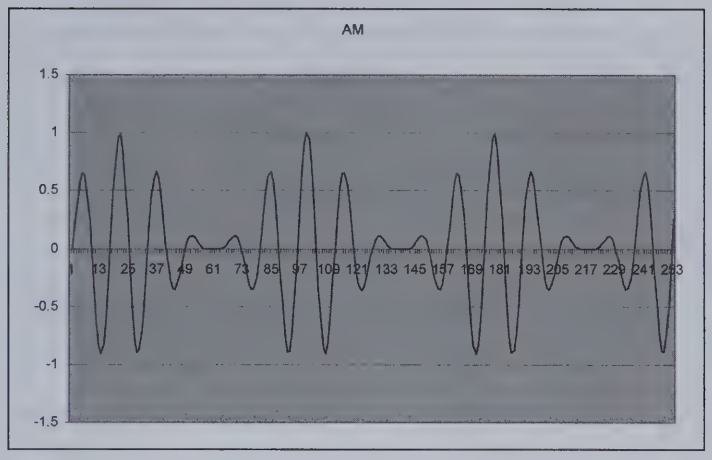

Figure 11a—AM signal at the input to the sound card.

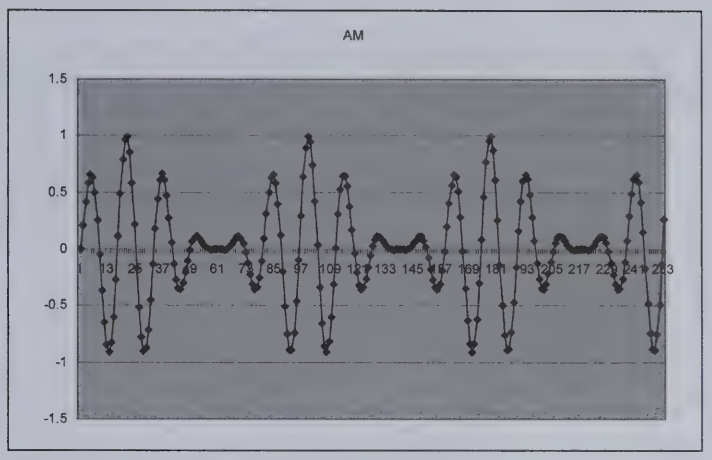

Figure 11b—Sampled AM signal.

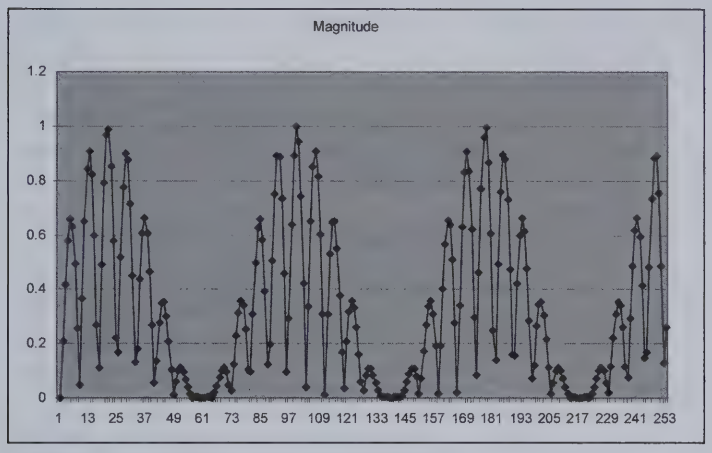

Figure 11c—Magnitude of AM signal.

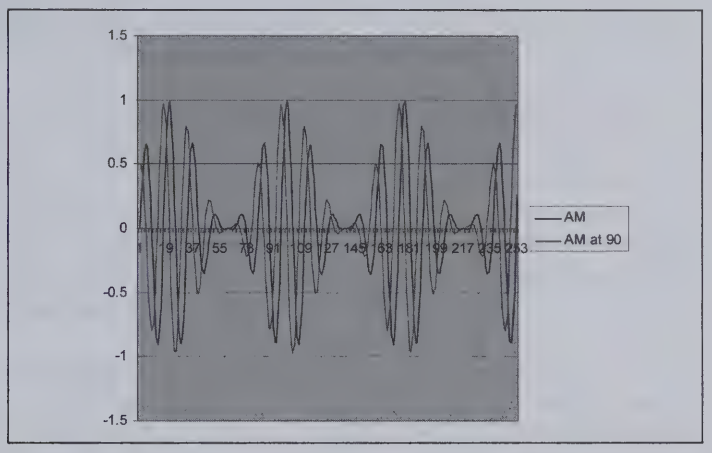

Figure 12a—AM I & Q signals at the input to the sound card.

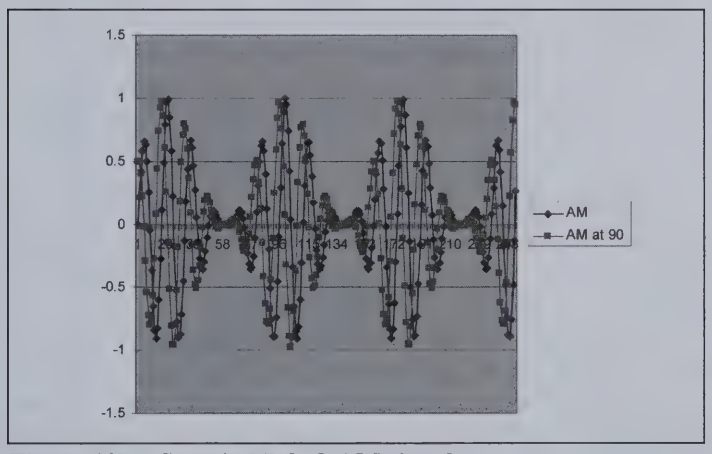

Figure 12b—Sampled I & Q AM signals.

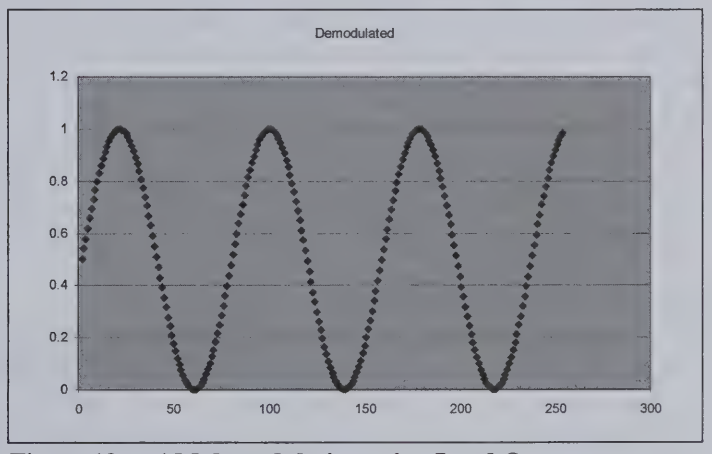

Figure 12c—AM demodulation using I and Q.

but there is a good reason for not simply doing it that way and using both the I and Q signals instead.

The reason is as follows: The incoming signal has been mixed down to a frequency within the input range of a PC sound card, generally in the range 10 to 20 kHz. Let's assume our signal has been mixed down to 10 kHz and is being amplitude modulated with a 1 kHz sine wave, so at the input of the sound card we have a signal that looks like that in Figure 11a. Inside the sound card, the signal is converted to a series of samples, represented by the dots in Figure 11b. We then calculate the magnitude of each sample, which results in the signal in Figure 11c.

If this signal were to be fed directly to the DAC in our sound card, we would end up with a strong component at 10 kHz. Sure the signal could be low pass filtered before passing it to the sound card, but let's see what happens if we use the I and Q signals as proposed above.

Figure 12a shows the I and Q signals being fed into the sound card. Note the 10 kHz carriers are 90-degrees out of phase with

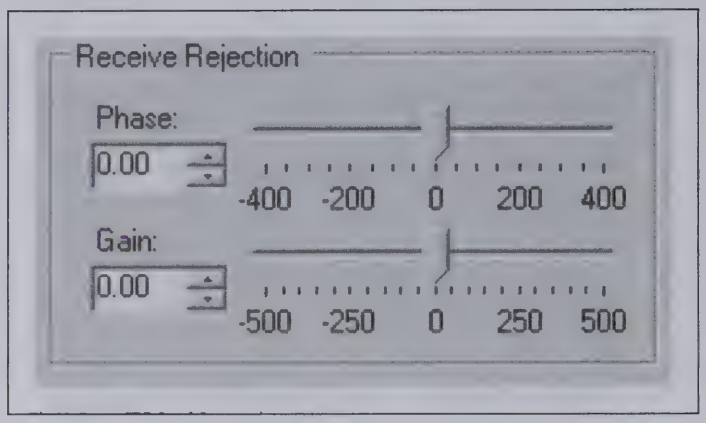

Figure 13—PowerSDR I and Q correction.

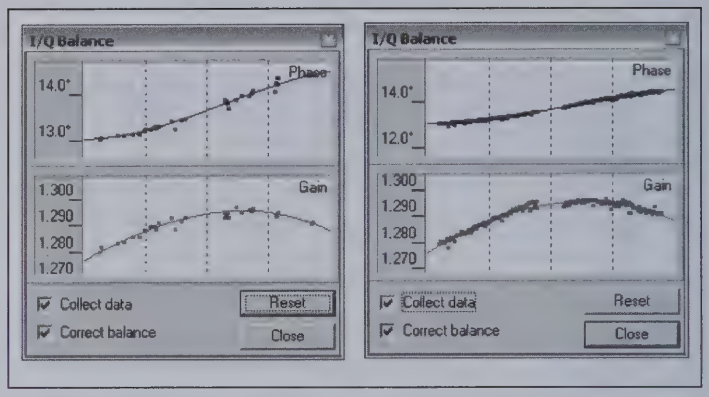

Figure 14—Rocky phase and image rejection before and after the learning period.

each other. As before, each signal can be sampled inside the sound card, which results in the values shown again with black dots in Figure 12b.

We now apply Pythagoras' theorem and the resulting signal is as per Figure 12c. Notice that the 10 kHz carrier component is no longer present in the output signal. By using the I and Q signals, we have eliminated the need to filter the demodulated signal. What is even more useful is what would have happened if we had mixed the AM signal down to an even lower IF, say 1 kHz. Since 1 kHz is within the audio range, it would apparently have been impossible to filter out of our demodulated signal.

However, when using the above technique, the IF frequency does not appear in the demodulated output. Note that the technique works even if we use zero Hz as the IF.

CW & SSB Demodulation

For CW and SSB, the same techniques can be used as in the analogue system of Figure 2. We simply shift the phase of all signals passing through either the I or Q channel by 90 degrees, and then add the resulting signals.

However, there is one major difference. Since mathematics is being used to build the LPFs and provide 90-degree phase shifts, we can design these to provide identical amplitude responses and exactly the desired phase shift we require.

Phase and Frequency Modulation

Let us now round off the analogue communication modes. Given I & Q, we can demodulate a Phase Modulated signal using:

PM = tan-1(Q/I)

And for Frequency Modulation

$$FM = (Q_n \cdot I_{n-1} - I_n \cdot Q_{n-1}) / (I_n \cdot I_{n-1} + Q_n \cdot Q_{n-1})$$

where n = current sample and $n - 1$ = previous sample

Are we there yet?

The end result is that there is no need to be concerned about maintaining amplitude and phase accuracy once we are in the digital world. However, what about all those analogue components that are used prior to the ADC on our sound card?

Well unfortunately these components will degrade our image rejection performance, but all is not lost since we can compensate for consistent phase and amplitude errors digitally.

Most of the SDR software packages provide for either manual or automatic reduction of the image response. Figure 13 shows the amplitude and phase adjustment controls provided in the PowerSDR program.

The operator tunes to a sufficiently strong signal within the band and adjust the controls to null the image signal. With careful adjustment, over 90 dB of suppression can be obtained with this method. Unfortunately, if this is done at a single frequency—say, in the middle of an amateur band—then the image suppression will have dropped to less than 50 dB at the band edges.

In order to improve this situation, it is necessary to adjust the image suppression at multiple frequencies across the width of the band. This could be done using an external signal generator but fortunately there is a simpler, automatic solution.

It is very easy to write some software that will accurately measure the frequency of every signal in the audio passband of the sound card. Since we know each frequency, we can also calculate what frequency its image will be on and automatically null it.

This is the innovative technique that the highly popular Rocky software [3] written by Alex Shovkoplyas, VE3NEA utilises. Basically the software uses on-air signals to build up a "map" of what phase and amplitude corrections are necessary to null the image signals across the sampling bandwidth.

In effect the software "learns" how to make these corrections over time. The longer the software runs, and the more signals it is subjected to, then the greater the accuracy of the image suppression. Figure 14 shows Rocky's phase and image rejection process after a short learning period and then after a much longer period.

Unfortunately, this automatic method is not the perfect solution, since it needs to be performed on each amateur band used—a time-consuming exercise. Also, changes to the receiver input circuit, SWR, different antennas etc, frequently require the "learning process" be repeated.

There is a lot of research presently going on to find ways of overcoming the image problem. One that looks promising is to insert a very narrow pulse into the SDR's antenna socket. This has the effect of simultaneously producing a wide range of frequencies. With suitable software, it may be possible to automatically image null an entire amateur band very quickly.

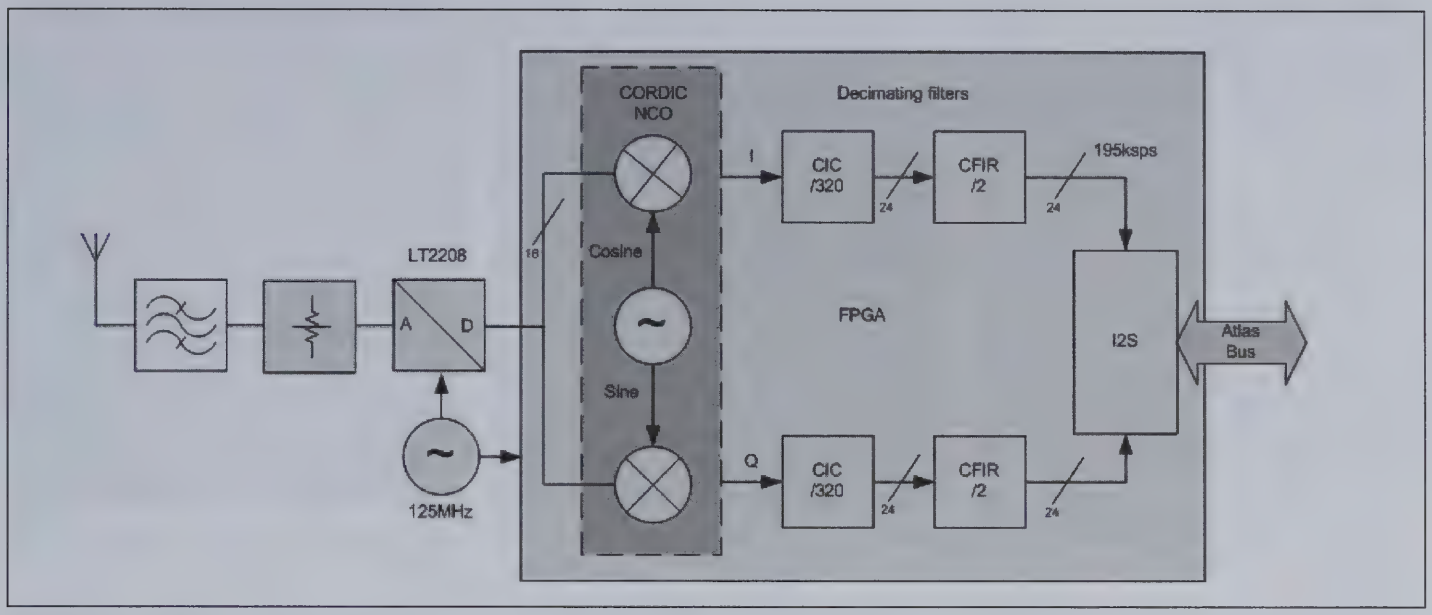

Figure 15—Digital down conversion.

A fully digital solution

Whilst the sound card approach to SDR has served us well in the early days of moving from analogue to digital receivers this is likely to be a short-lived solution. We are starting to see ADC chips that can be used to directly sample the entire HF spectrum from an antenna connected directly to its input. Admittedly, these devices are not cheap, in the order of $100 at the moment, but we can expect to see substantial price reductions, and performance improvements, in the future.

By replacing all the amplitude and phase-sensitive analogue components with a single ADC, and then creating the I and Q signals digitally, a phasing receiver (and transmitter) can be produced that for all practical purposes has perfect image rejection. The block diagram of a receiver that uses this technique, which is called Digital Down Conversion, is shown in Figure 15.

It is exactly this architecture which the next generation of fully digital HF and VHF receivers are using. The phasing technique has indeed come "full circle!"

Biography

Phil Harman, VK6APH, has held an amateur radio license for over 40 years. For much of this time, Phil has worked on leading-edge RF techniques related to receivers and transmitters. His current passion is the development of fully-digital HF radios. Phil co-authors the monthly "Software Defined Radio" column in the Radio Society of Great Britain's *RadCom* journal. He has also co-authored the SDR chapter in the latest *RSGB Handbook*, with his friend Steve Ireland, VK6VZ. ●●

DID YOU KNOW...?

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QRP Clubhouse

Timothy A. Stabler—WB9NLZ wb9nlz@yahoo.com

Hello again from Northwest Indiana. My new house is slowly going up and I cannot wait until I get in. My builder tells me he is putting a 2-inch conduit in from the basement (my new shack) to the attic so I can rig any antenna I want to up there not having to worry about subdivision restrictions.

I must start off by apologizing to Jonathan Haynes, KC7FYS. He sent me a note that he would be operating QRP from Vietnam July 27-August 20 operating as XV2OC. His mention of his exploits will be online at www.flickr.com/photos/jonathancharles. He was going to operate 40/20 only using his ATS3B and wire antennae. I hope you made some good contacts Jonathan, but my column did not go in until well after your trip. Maybe some people can get in touch with him if he takes another trip in the future in order to set up contacts.

News from people and what they are up to has been very slight even after I contacted some groups but did come up with a few happenings. I did contact the qrss ts/rx group and received mail from Dr. Andrew Smith, G4OEP. The group is in the Yahoo Groups and looks at receivers with a signal frequency filter design. On his website, www.g4oep.atspace.com/qrss/qrss.htm, he includes pictures of signals received with computers and the milliwatts being used. For us QRP people, I found this stuff to be very interesting.

Bob Sulanke, KE7GKM, is looking for people in Southwest Idaho area to start a qrp club. He is located in Boise. The Reno QRP Group, W7FST, will be celebrating its 10th anniversary October 4 through the 12th on 10-160 meters. If you wish a QSL or SWL "Special Event" card for confirmation, please submit request to Steve Lybarger, 3234 Clay Alpine Dr., Sparks, NV 89434.

Ed Breneiser, WA3WSJ, wrote to introduce everyone to the Great Outdoors Club-GORC (pronounced GORK). The main focus is portable operation but not many QRPers have joined in. GORC presently has two awards including the Worked All GORC award or WAG award, and the GORC Century Club Award. Each award is numbered and can be seen on the GORC website, www.wa3wsj.org/GORC.html. The website has instructions on joining the group. Right now, there are over 120 members. If you work a GORC Member, don't be surprised to hear "you have been GORC'd."

Here is Ed Breneiser, WA3WSJ, founder of the GORC club, working somebody on the Applachian Trail.

Dar Piatt, W9HZC, working on his Stinger.

Quarter Century Wireless Association

In my original correspondence, I asked about what groups had done for Field Day. I had a note from NK8Q, Mark Schriener, about W3GS operating 2A Battery QRP this year. W3GS is the club memorial call-sign for the Quarter Century Wireless Association, Chapter 17, located in the Lehigh Valley area of Pennsylvania. The group operated from the home QTH of Chapter President, Ray Bilger, W3TDF. Don Curtis, W3LR, and Mark Schreiner, NK8Q, operated the CW station. Both were instrumental in introducing the "art of QRP Contesting" to the local chapter a few years ago when both had newly built K2s. Since then, this has been the contest style of choice.

Jon Mordosky, N3ZIL, who recently joined the Chapter was present from the EPA QRP club (www.n3epa.org). He also brought his son. Another avid contester, Jay Mason, N3OW, joined the group for the first time. He also brought his son. Jon and Jay both operated the HF SSB station while Jon's son (also named Jon) and Jay's son, Jeremiah, operated VHF on 6m SSB. This was sort of tough with QRP and a broken rotor. The host, Ray, operated all three stations as time permitted. Chapter Secretary and Treasurer, Mike Donio, K3NWM, also operated the SSB station during the opening hours of the FD event.

Although the setup was not the most ideal, everyone had a good time and the group managed a fairly good score. Probably at the bottom of the sunspot cycle right now, the score was better then the same setup two years ago.

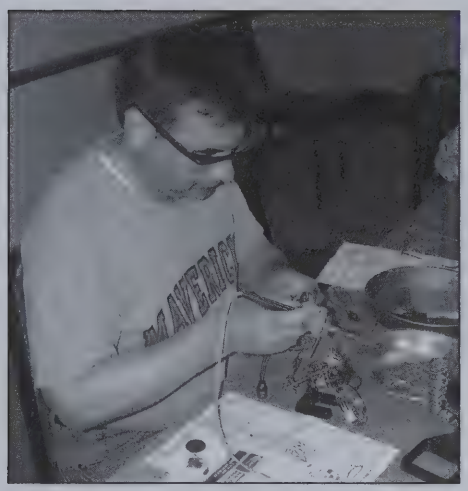
Food was sort of a potluck affair with a deep fried turkey being cooked by Mark, NK8Q. Chips, pretzels and some sausage sandwiches made available by Don, W3LR. There were some nasty thunderstorms at the beginning of the event and later in the evening but nothing too severe to stop operating.

80-10m was operated by both stations with 80 and 40 being equally good and providing the greatest number of contacts. Higher frequencies did open up for a good number of contacts as well on 20, 15 and 10m. This should remind everyone that bands do open up occasionally.

Midwest Homebrewers and QRP Group

The July meeting of the Midwest Homebrewers and QRP Group was a good gathering. Two projects were being worked on by the group.

The "primary" group project for this meeting was the Stinger Singer from Norcal (www.norcalqrp.org). The little device is a Morse code frequency counter that has two versions with each version having two speeds to choose from. The slow version of the kit is 13 or 18 wpm and



Jim Kilby, KGØRD, working on his Stinger.

Darrel Swenson, KØAWB, sorting out parts before starting on his Stinger.

Ray McNally, N5SEZ, working on his 2N2222 transceiver Manhattan style.

the fast version is 18 and 27 wpm. The kit was designed by Dan Tayloe, N7VE, and originally offered by the Arizona ScQRPions QRP Club (www.azscqrpions.org).

The second project was a "Manhattan" transceiver project built in modular fashion. Ray McNally, N5SEZ, has the prototype and several members spent their time gluing pads and attaching components. This will be similar to the 2N2222 transceiver. Hopefully some will be done by them September meeting. Several Stingers were completed during meeting time.

Meetings are the second Saturday of the odd numbered months at them Breadeaux Pizza Place at 11 AM, in Ashland, NE. Everyone is welcome.

If interested, you might want to look at their website, www.members.cox.net/w9hzc/homebrew, and sign up for their email. Darwin Piatt, W9HZC, puts out a weekly listing of contests coming up during the week.

4SQRP Club

Although now over, Terry Fletcher, WAØITP, Bart Lawson, WØIIT and Joe Porter, WØMQY, set up a QRP sprint at the site of "Big Brutus" near West Mineral, Kansas on August 24, and were going to go all day unless the sun or propagation got to them on 40, 30 and 20m. Modes were CW and SSB near the standard QRP frequencies. Everyone they contacted will receive a QSL postcard with "Big Brutus" on the front. This was a trial run and they have received permission from the Big Brutus Board to make this an annual event. Be ready next year. Keep your eye on their email, which you can sign up for at their website, www.4sqrp.com.

That is it for now. If your group has anything for the future or are doing now, please email me and let me know. I do ask, however, that you put "club doings" as the subject line so I do not unintentionally delete it. ●●

The Midwest Homebrewers hard at work.

What's *YOUR* QRP club doing...?

Send news to Tim, WB9NLZ at wb9nlz@yahoo.com

OzarkCon 2008 Wacky Key Contest

Terry Fletcher—WAØITP wa0itp@mchsi.com

The first annual OzarkCon Wacky Key Contest was held at OzarkCon 2008. The keys had to conform to only two requirements, they had to be able to key an oscillator and they had to be capable of sending code.

There were many entries and the event was considered a rousing success by any measure. The entries displayed a sense of fun, innovation, and no small amount of imagination, engineering and craftsmanship. Not to say evidence of rapid building techniques.

The clear-cut winner was the old Datsun Tailgate Key entered by Walter K5EST. Every one else came in 2nd place. Walter said he pulled it out of a ditch on his farm, and it took two days to clean it up.

The variety of designs was a hoot. Ranging from the huge (Walter's) to the tiny, Tom, N2UHC's duck call like oral actuator.

Walter's winner featured water pipe foam insulation "springs" and a heavy fist. It worked pretty well actually. WAØITP's entry was the "Ten Foot New-Ma-Tic," which was a leaf contact actuated by a can of compressed air through ten feet of clear tubing. Tom N9UHC's duck call was ingenious; he blew into the end of a PVC pipe to close a diaphragm switch. It was all anyone could do to call a 3 × 3 CQ, hi!

Another nicely done entry was an iambic computer mouse key. It was very well crafted, and was quite useable.

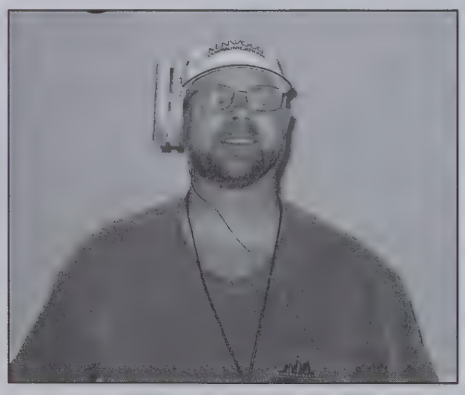
This was a very popular contest and the proof of the pudding was the large crowd surrounding the table, and playing with the keys whenever there was a break in the other activities.

The contest will be back next year and the designs will undoubtedly be mind-boggling, again.

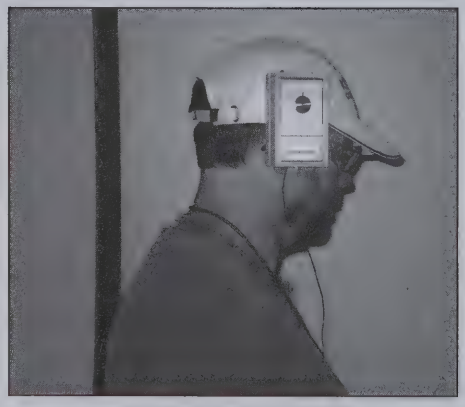
As Jay Bromley, W5JAY, said afterward, "This does make me wonder what goes on inside the mind of the man that comes up with these concepts."

WAØITP's "Ten Foot New-Ma-Tic" air-powered key.

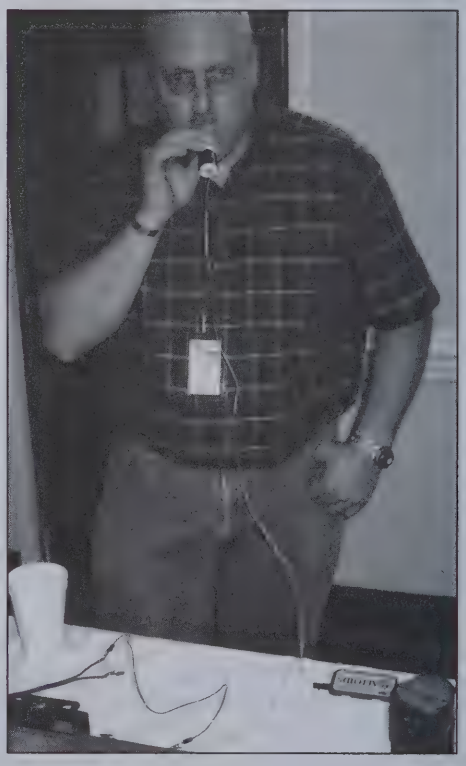
K5EST at the keyboard.



KCØPET sending.



KCØPET wearing key



N2UHC calling CQ

My Retro Station

Dick Arnold—AF8X af8x@comcast.net

I got a late start into ham radio. At age 44 I had never had the opportunity to meet an amateur radio operator; however, I had always been fascinated with the Morse code and learned it as a Boy Scout, the only hitch being, none of my friends shared my interest. So, I only learned to send code with one of those toy key/oscillators that were popular back then, and I had no receiving practice. As the years passed, I became interested in aviation and that filled my every thought, until my son Gary announced that he was about to buy a Heathkit HW-101 and become a ham. He was in the Air Force at the time and stationed at Nellis AFB in Las Vegas, Nevada. Las Vegas sounded like a good place to take a winter vacation, so the XYL and I planned to fly out to spend a week with our son and his wife.

When we arrived, Gary had already passed his General exam and we spent many hours in front of the HW-101. I was thrilled to hear all the JAs and VKs coming in S6 to S9. The embers of my previous interest in Morse were soon fanned to a blazing conflagration that consumed me. Every waking minute I listened to the dits and dahs emitted from squeaking automobiles, tweeting birds, and the wind-blown noises from outside the house. In other words, I heard Morse everywhere!

AF8X and shack.

After returning home and passing the required tests, I too was a Ham! At that time there was a local Heathkit store where I purchased an HW-8 kit; but I didn't feel equal to the challenge of the HW-101. I built the HW-8 in record time and was thrilled to operate my very own station. I installed a Hustler antenna on my vehicle and took the HW-8 everywhere. Those were my early days of radio, and now 25 years later, I regret selling the little HW-8 even though my present equipment is technically far superior to the rigs of that period.

Although I am not one of the real old timers who started with the home-built or commercial boat anchor equipment, I think of that time as the "Golden Years of Radio" and wish I could have gotten an earlier start; however, the '70s were my Golden Years, and when I see pictures of an HW-8, I am captivated by nostalgic memories. That's why I decided to buy an HW-8 and restore it and try to relive that precious time in my life.

I found several HW-8s on Ebay, and I was the winning bidder on one with the matching HWA 7-1 power supply. While waiting for it to arrive from New York, I brought out my Vibroplex bug and started practicing until I could send smoothly, without mistakes. I made a few contacts on the air using it and everyone seemed to copy okay, so I was satisfied with my progress. I plan to use the bug with the HW-8 as part of my retro station.

When the HW-8 finally arrived (it took over a week from New York) I was pleased at the cosmetic condition and put it on a dummy load to check the transmitter power. Maximum out was 2.5 watts on 80 meters. A little less than I had hoped for, but okay for now; perhaps later an alignment may help. I hooked up the Carolina Windom and answered a CQ from W2EXB in New York and received a 569 report. I kind of felt sorry for him trying to copy my bug-generated Morse. I made several mistakes and didn't realize until later that my headphone wire was interfering with the bug dits. I hope Chas will forgive me.

Putting this station together has given me a lot of pleasure, and even though I am lacking the enthusiasm of my "youth," it reminds me of a very happy time in my life. The use of the Vibroplex bug is a result of my trying to emulate the operating technique of a good friend and mentor, John, W8URM (SK). John was the most perfect bug operator I had ever heard. I will never be that good, but when using the bug, it takes me back to "the good ole days."

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www.qrparci.org

The club web site is an important part of its role as the leading international QRP organization. Put this URL in your "Favorites" list and check it often to stay on top of QRP happenings!

The Z-Pole: An Asymmetrical Halfwave Vertical Dipole for 30m & 40m

Ade Weiss—WØRSP aweiss@usd.edu

This antenna began with two QRPers reading in the April 2004 *QST* ("The 'C Pole'—A Ground Independent Vertical Antenna," pp. 37-39) about KF2YN's "C Pole" halfwave vertical dipole and considering its potential as a portable system mounted on a telescoping fiberglass mast or hung from a support such as a tree. Then, at FDIM 2005, I stepped through a flap in the Holiday Inn Le Grande Banquet Tent to go outside for a pipeful, and almost bumped into Peter Zenker, DL2FI, coming in from a cig break. Peter wanted to share with me his latest portable antenna design—a vertical that did not need a bunch of radials and was quick and easy to erect. As luck—or actually, the weather—would have it, a U-Haul truck with panels covered by a thick film of muddy highway spray was conveniently parked outside the flap, and after a short while, most of the reachable side of the truck was covered with Peter's diagrams and sketches.

Antenna Concept / Theory

In KF2YN's basic design, a halfwave dipole is mounted vertically. In order to minimize the height, both halves of the dipole are folded back on themselves with a spacing of about 3-ft on 20m, producing a reduction in physical length of greater than 50% (see Fig. 1). The folding results in a low impedance (relative to 72 ohms in a fully extended dipole) of about 23 ohms at the physical/electrical center of the dipole. When this folded-back dipole is installed horizontally, the distribution of voltage and current in the traveling waves on the two halves remains symmetrical (i.e., sinewave, zero current and maximum voltage at the ends which are now near the physical center of the dipole). The capacitive coupling to ground is equal for both halves since their height and length are identical.

A vertical halfwave dipole's interaction with the ground under it is radically different than is the case with a quarterwave vertical monopole. In the latter, the ground and radials replace the missing half of the dipole and form a return path for the RF current fed into the feedpoint at the base of the vertical. If only a few or no radials are installed, the return path loss is very high and absorbs a significant amount of the RF signal fed into the vertical at its base.

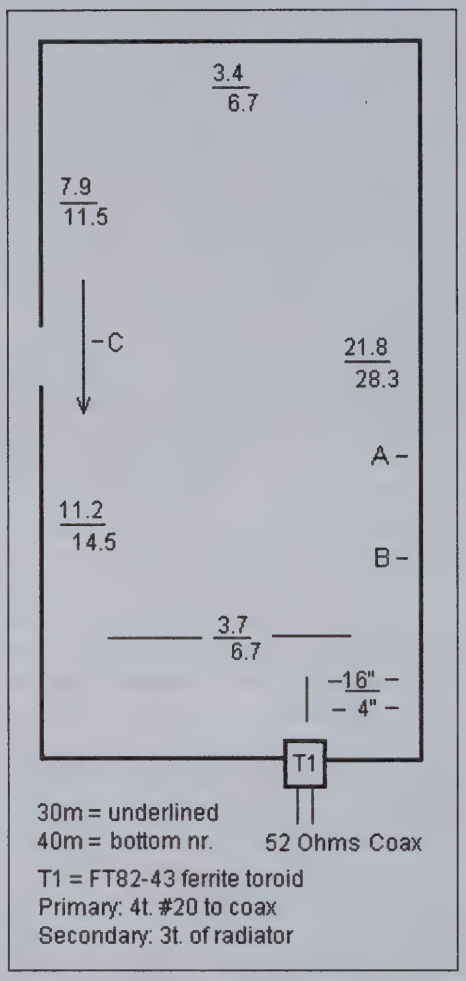

Figure 1—Geometry and dimensions (in feet) for 30m (underlined) and 40m versions of the Z-pole asymmetrical halfwave vertical dipole. Height above ground is about 3.2-ft for 40m, 7.8-ft for 30m. #22 enameled wire is used for the radiator.

However, the halfwave vertical is a complete antenna system with its own "return path" consisting of the two sides of the dipole. It does not depend upon radials or ground for completion of the circuit. But its proximity to ground does have an effect on resonance and ground loss. When mounted vertically, the proximity of the lower half of the dipole to ground significantly increases that end's capacitive coupling to ground. Hence, compared to the more distant upper half, wave travel on the near-ground half is slowed down because ground is lossy and is a very poor medium for RF waves. As a result, the electrical center of the dipole shifts away from its physical center (Figure 1, point A) toward its ground end. If the feed point were then moved to where the new electrical center is (Figure 1, point B; the shift distance is exaggerated for clarity), the physical lengths of the two resulting "halves" of the dipole would not be equal. The ground end would be physically shorter, but the wave travel time along it would be equal to that along the longer upper end. Hence, such a vertical dipole is often described by verticals such as the GAP Titan where the ground-end half, instead of being folded back on itself, is formed into a "wheel on spokes," like in an old capacity hat that is placed at the bottom instead of the top of the vertical. The technical term for this arrangement is "asymmetrical vertical dipole." The concept has been applied in commercial antennas. In general, the coupling to ground by the Z-pole exhibits the same height vs feedpoint impedance effects (but not quantities) as with a horizontal dipole. (See my discussion and measurements of "resonant" ground radials in "The St. Louis Vertical, Radial and Express," *QQ,* October 1999, p. 37, and Part II, January 2000, pp. 23-24; also, various editions of *The ARRL Antenna Book.*) Figure 2 plots values of resistance and reactance calculated by EZNEC for heights ranging from 1.5 to 20 ft. for my 30m version. At around 10-ft, the reactance hits zero (+j0.04 ohms = resonance for the frequency of operation) and levels out. The antenna becomes primarily self-resonant unless it is coupling into some nearby large conductive object. The actual shift in resonant frequency is minor. In the EZNEC modeling of my 40m version, which is quite close to ground (~3.2-ft), the change is only about 50 kHz dropping from free space to 4.2-ft above real ground as seen in Table 1. This is understandable

H feet	Fres	Zin
FreeSp	7.05	23.5 –j0.54
40.2	7.05	22.2 –j1.0
20.6	7.06	26.9 –j0.46
10	7.05	34.4 –j0.9
4.2	7.00	43 –j1.1

Table 1—40m version height above ground vs. resonant frequency and impedance

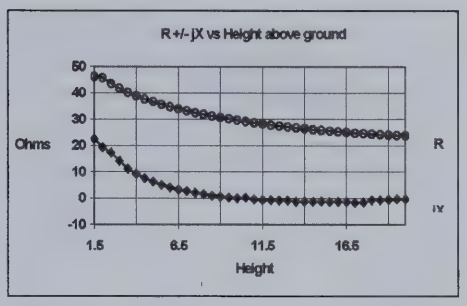

Figure 2—EZNEC Plot, showing the variation in radiation resistance "R" and reactance "±jX" vs. the height of the bottom horizontal section above average ground.

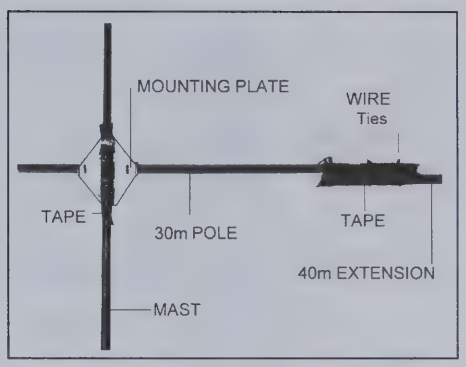

Figure 3—Details of mounting the 40m version top spreader about midway up the top section of the DK9SQ mast against a thick wrapping of tape. Holes matching the diameters of the mast and spreader are drilled at the corners of the mounting plate and loops of #22 wire fed through and twisted tight to secure the two (see text).

in view of the fact that the bottom spreader is only 6.7-ft long; meaning that only about 10% of the entire radiator is parallel to and closely coupled into the ground.

In addition to not requiring radials, the folded halfwave vertical dipole exhibits a second major advantage with respect to its feedpoint location. If it were fed at its physical center (Figure 1, point A) as in a horizontal dipole, two problems would arise. First, the impedance at that point would be about 23 ohms (SWR ~2.2:1) and some form of matching to 50 ohms coax would be required. Second, the feedline would have to be run perpendicular to the vertical for some distance to avoid RF currents on the line caused by coupling into the radiated field. The two problems are mitigated by the fact that the electrical center shifts (as described above) toward the ground end. As a result, the current begins to drop off along the horizontal section at the bottom (as well as the top) causing the impedance to rise to a range for easily matching to 50 ohms. For example, the calculated values for my 40m version show a rise from Z = 27.3 + j4.4 ohms to Z = 43 – j9.5 ohms along the bottom horizontal section. The use of a ferrite toroidal transformer (wound on an FT82-43 ferrite core, μ = 850; see Figure 6) as an adjustable method of inductively coupling the 50 ohms coax to the vertical allows for a SWR = 1:1 at the resonant frequency. Obviously, a feedline connected at the bottom section is a luxury in regard to measurements and adjustments (and concealment in stealth situations).

Construction

In constructing the antenna, the first step is to mount the vertical in whatever configuration works in your situation. As noted above, one approach is hanging the vertical from a tree with 3/4-in PVC spreaders and "plumb line" or cord, and anchoring it at ground level as in KF2YN's installation (see "The 'C Pole'," p. 39). Alternately, a 30m (or higher bands) version could be tacked to the eaves at the peak of my roof at 28-ft (a bit low for a 40m version). Or, a rope could be stretched between two trees at the correct altitude and the vertical suspended at the desired location. Stealth possibilities often exist in wooden apartment buildings.

But both Peter, DL2FI, and I were attracted by the potential of the concept as an easily transported and erected radialless vertical for portable and road-trip operation, especially on the lower bands (30m, 40m) where effective heights for "long-enough" random wires are often difficult to find. My decision to try the antenna had to await the epiphany provided by Peter's U-Haul explanation of his solution to the feedline connection problem. The logical choice for mounting at the necessary heights was DK9SQ's 10m (33-ft) Fiberglas-Teleskop-Tower (collapses to about 4-ft). [1]

For the 30m version, the handle of an old fiberglass fishing pole was cut off to produce the 3.4-ft top spreader which was "X-lashed" with #22 wire at its balance point about midway on the mast top section. The longer radiator (~ 66.4-ft folded to 28.3-ft height) of the 40m version required considerably wider spacing to fit on the 33-ft mast. Walmart happened to have a 13-ft telescoping fiberglass crappie pole (about $9.00) whose top section could be lashed to the 3.4-ft 30m spreader to produce the 40m 6.7-ft top spreader (see Fig. 3). Two 3-in pieces of #10 or #12 house wire were taped together with the bases of the 30m spreader pole and crappie pole (forming a "bundle" of four parallel shafts) and secured with three 2-turn windings of #22 wire ties. A 1 3/4-in square mounting plate was cut from very light aluminum stock with holes drilled in the corners to match the mast top section and spreader diameters. A thick wrapping of tape at the junction area of the mast prevents vertical slippage of the spreader which is mounted at its balance point. Nylon ties could not be tightened sufficiently, so wire (#22) ties were used instead.

A pair of the XYL's 1/4-in bamboo plant sticks was taped together for the 30m 3.7-ft bottom spreader. Figure 4 shows the details of mounting the 40m bottom spreader. By coincidence, the two lower sections (#2 and #3) of the crappie pole served as the 6.7-ft bottom spreader. The mounting plate was cut from 1/8-in masonite and holes drilled to match the diameter of the spreader, which was secured with the small size nylon ties. Then I came up with a "genius" solution (I say this in all humility!) for attaching the mounting plate to the mast—the innertube (cut into 1.5-in strips) I'd just removed from my 10-speed bike. It was another small surge of genius to see that a simple wrapping of innertube strips at the joints of the mast would keep them from slipping in prolonged use (4 months at least). The spreader bows down about 6-in with the radiator installed (see Fig. 5). In both versions, the radiator is secured to the mast (tape and #22 loop) at about 10-in above the top spreader rather than running along

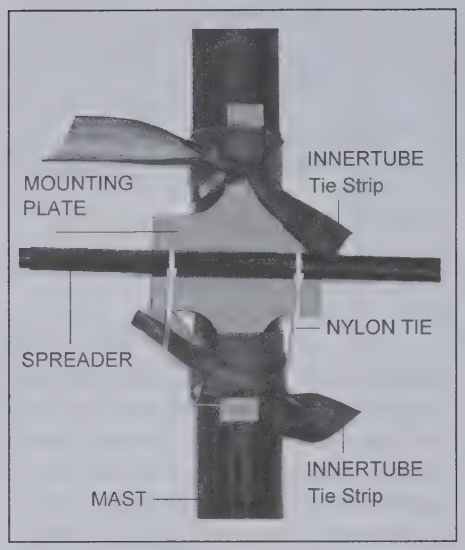

Figure 4—The bottom spreader is secured to the 1/8-in masonite mounting plate with small nylon ties, and the assembly is secured to the mast with rubber tie strips cut from a bicycle innertube (see text).

Figure 5—The 40m top spreader bows about 6-in with the radiator wire installed. The wire is secured to the mast about 10-in higher up.

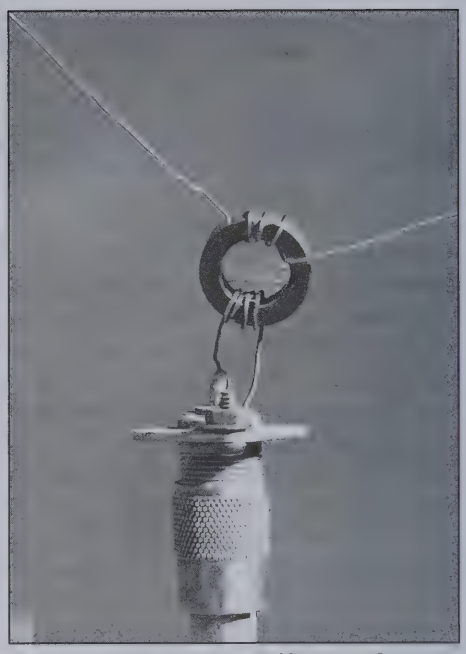

Figure 6—The FT82-43 transformer. The secondary is about 4 wide-spaced turns of the radiator wire; the primary is a tight 4 turns of #22 connected to the coax through the usual PL259/SO259 plug/socket.

it. The wire is wrapped a couple of turns around the ends of the spreader. The bottom spreaders are thick enough at the ends for small nylon ties which serve as eyelets for the radiator wire. The ends of the radiator are twisted into small loops which are then connected at the gap with an appropriate length of 1/16-in nylon plumb line tied in a "reversed half-hitch" knot at one end (the size/length of the resulting loop can be adjusted—extremely useful in antenna work).

The top section of the mast is strong enough to carry, without vertically sagging, the weight of about 60-ft of #22 and the 6.7-ft fiberglass spreader mounted about midway below the tip.) The arrangement has survived 50-mph gusts and been bent close to horizontal—you watch in horror at first, then realize "that is what it is made to do—fly." In my situation, I was in luck for a mast support. I swung the mast to vertical and slipped the open base end onto a long-shafted screwdriver set in the ground at the right point and leaned the mast against the top 2 × 4's of the XYL's flower arbor (not recommended!) at about 7-ft up, and tied it in place with an innertube strip. I also could have leaned it against the eave of the roof of the garage or house. In a portable situation, rigging three guy lines at about 6-ft up the mast (secure with a wide innertube strip) and the screwdriver base would suffice for a temporary installation. Also, a picnic shelter roof, wood poles holding up a sign, fence posts etc. could serve as a support. With the vertical up, the next steps consisted of trimming it to resonance and finding the best spot on the wire for matching to the coax feedline via the toroidal transformer.

Tuning/Adjustment

Enter the genius of Peter, DL2FI. KF2YN had connected the feedline directly into the cut antenna wire through a balun that was constructed from RG-174U coax, the industry standard for lossy coax, and although it would eventually choke off the current on the feedline, the loss would still occur, and in the meantime, the resonance of the antenna would be significantly impacted. The match between feedline and feedpoint depended entirely upon finding the exact 50 ohms point on the radiator and could not be improved except by lengthening and shortening the sides of the dipole [2]. But Peter had capitalized on a more flexible and efficient feed method, namely, a simple inductive coupling transformer consisting of a primary winding to which the 50 ohms feedline was connected, and a secondary winding formed by the unbroken antenna wire itself (see Fig. 6).

The beauty of Peter's approach became obvious to me the instant that he drew it on the U-Haul! That is how a G.D.O. (grid-dip oscillator), long the primary instrument for the job, measures the resonant frequency of a radiator! The G.D.O.'s oscillator coil is placed close to the radiator wire to establish inductive coupling. But, if an adequate dip is not obtained, the radiator wire when looped one turn around the coil will produce a marked dip at resonance.

Newcomers to antenna experimentation often wonder why so much emphasis is placed on trimming an antenna to resonance, and draw what seems a perfectly logical, but incorrect inference. Actually, a perfectly resonant antenna does not radiate more efficiently than a non-resonant antenna (until the radiator electrical length has been reduced by >30% or so). My 30m dipoles up about 45-ft, for example, have racked up around 90 countries—on 40m! Talk about non-resonant! But they will not work on 80m—far too short. All RF power fed into either class of antenna is eventually radiated minus the loss that is caused by the repeated trips of the reflected (from the ends of the antenna) waves back and forth through the resistance of the radiator conductor, which is usually copper, of very low (negligible) resistance. The problem is the loss caused in the trips of reflected waves back and forth along the feedline. Except at exact resonance, some degree of phase difference (i.e., "phase" = time point, such as "53-degrees into the cycle," on the sine curve) between the wave arriving at the feedpoint on the feedline and the part of the previous wave that has been reflected

to the feedpoint. That difference is expressed in the "imaginary" term "reactance," which is given either as a phase-leading ("+j", inductive) or phase-lagging ("-j", capacitive) ohms. Reactance is one measure of the mismatch which causes a reflection of part of the incoming wave back to the transmitter end of the feedline. The radiation resistance that actually dissipates the incoming wave via radiation is the other measure. An antenna tuner or transmatch can be inserted between feedline and transmitter to cancel the reactance and transform the resistance at that point, but that has absolutely no effect on the mismatch at the antenna feedpoint. The bottom line is: a resonant antenna exhibits very low reactance (the "±j ohms" part of impedance) at its input terminal, greatly lessening the feedline loss that the very high reactance of a non-resonant antenna causes. (For the authoritative discussion of the above topics, see M. Walter Maxwell, *Reflections: Transmission Lines and Antennas,* first edition, by ARRL (1990), or the second edition *Reflections II,* from Worldradio Books (2001)). So, many of us veteran QRPers use 300 or 450 ohms ladder line with its minuscule loss (even at high SWR) as a matter of course—why take the small loss that even a nearly resonant antenna would cause if fed through coax? And an added benefit is realized—the ability to feed a single 30m dipole on all bands 40-10m without noticeable SWR loss.

The adjustment of resonant frequency in this case can be performed in two ways. First, the toroidal transformer's secondary winding (as would a coil inserted into the radiator wire) adds electrical length to the antenna and hence lowers its resonant frequency, but its inductance can be modified slightly by either squeezing together or spreading out the spacing of the winding. A turn or two could be added to (lowers frequency) or eliminated from (raises frequency) the secondary, but I have not tried that. The primary winding can be increased or decreased so as to achieve the correct impedance transforming ratio with a slight effect on frequency. Second, the actual length of the radiator wire can be lengthened or shortened, the most convenient method of shifting resonant frequency.

For this procedure, an instrument that is capable of measuring radiation resistance and differentiating positive from negative reactance is necessary (an SWR meter CANNOT). As noted above, a grid-dip oscillator is useful for locating resonant frequency (see the new solid-state dip meter "Dip It" available from DL2FI at the Web site http://qrpproject.de/DipIt.html), but it does not provide information about resistance and reactance. In practice, a negative reactance ("–j 9.5 ohms") indicates a too-short radiator, or alternately, a too-low frequency, and thus shows whether wire must be added to or trimmed from the radiator wire. An MFJ 204B "Antenna Bridge" in combination with a frequency counter or QRP receiver can locate frequency and indicate composite impedance (i.e., the resultant of both resistance and reactance). An "RX Bridge" such as the MFJ 202B (1974?) can provide all the data which must then be converted by formula to reactance values. "Modern" units with internal computer chips and LED readouts are favored by most antenna buffs. These include the misnamed deluxe MFJ 259B "SWR Analyzer" ($289.95, mfjenterprises.com), which actually measures and computes everything else as well, and the comparable but much smaller Autek Research VA1 Vector RX Analyst ($199.95. http://autekresearch.com). The MFJ and Autek units are connected directly to the primary of T1 through a minimally short piece of coax (see manuals). (See also my discussion of measurement techniques and instruments in "St. Louis Express …Part II," p. 21)

Once the radiator has been trimmed to resonance, the final step is to find the location of the feedpoint for a proper match to 50 ohms coax, if that is your feedline of choice. With coax feed, this is a single band antenna.[3] Instead of KF2YN's complicated and confusing method (see p. 39), Peter, DL2FI, simply kept moving the ferrite toroidal matching transformer along the dipole by continually rewinding the secondary 3-4 inches farther along the wire. So simple! As noted above, the radiation resistance will rise as the feedpoint moves away from the physical center of the radiator wire. (Incidentally, I discovered that the rewinding is easier if the wire is cut near to point B of Figure 1 in order to start with a short length instead of threading a 11-ft or 14-ft wire through the toroid for each turn!) I began with the transformer 2-ft above the bottom horizontal section and reached 50 ohms in the 40m version at 4-in into that section, which is 20.8-ft from the gap end, or at 31% of the total length (vs. 50% for a centerfed horizontal dipole). In the 30m version the feedpoint was 16-in in, which is 13.6-ft from the gap end, or at 28% of total radiator length. In all likelihood, the radiation resistance will rise along that segment to close to 50 ohms as indicated by the antenna analyzer. If the impedance range is still too low, a rotation of the rectangle formed by the folded segments (see Fig. 1, arrow C) will bring more of the gap-end wire down onto the horizontal spreader and provide a higher resistance for the match. Or, as noted above, if the readout is close, i.e., 45 ohms, squeezing the primary turns can zero it in (see Fig. 6).

Results

During a 4-month period (2008), the Z-Pole significantly outperformed EZNEC predictions (gain vs. radiation angle and aziumthal angle) on 40m in direct on-air comparisons with the 30m dipole at 45-ft. The CQ WPX DX contest at the end of May provided the only DX opportunity. The two antennas were switched continuously during calls of each of 18 QSOs so that the results suggest definite directionality: the 9 QSOs with EU/OC were on the 30m dipole, and the 9 QSOs with SA/Carrib were on the 40m Z-pole. The best opening (second night) produced 8 QSOs in about 1.5 hrs, with a 4-4 directional split. It thus seems that the 40m Z-pole "filled in" the nodes in the dipole's azimuthal pattern although EZNEC said the dipole should have been stronger. Interestingly, previous verticals (single Vern Wright, W6MMV, center-loaded vertical, a pair of phased W6MMVs, an 18AVQ, and my SDRV—see "South Dakota Resonant Vertical for 20-30-40 Meters," *QQ,* October, 2000, pp. 35-39) had been compared to the same EU/OC dipole (during solar cycle highs) with comparatively miserable results. That the 40m Z-Pole worked that much DX on 40m during the solar minimum is sort of a "mind blower" to me. For stateside work, I don't see any preferential azimuthal pattern—perhaps the pattern is occurring in the elevation angles, or perhaps it is just random. Listening comparisons in 2007 between the dipoles and 30m version favored the dipoles most of the time. Conditions prevented any DX QSOs on either antenna,

although the Z-Pole got a "QRZ?" from ZL2AL! It also worked well for stateside QSOs although the dipole directionality was more evident.

Given the solid performance of the Z-pole, I will definitely leave my old quarter-wave verticals and radials at home in future portable or road-trip operation on 40m and 30m. At the home QTH, the Z-pole can compete quite well with a low, short dipole (48-ft, 45-ft up) on 40m where considerable height and horizontal space is needed for a full-size dipole. The 40m version has a small footprint, but it is a big antenna above ground and definitely not stealthy mounted on the mast! On 30m, I would prefer my pair of dipoles at 45-ft, given my present space, and fed with twinlead, they would probably be superior to the Z-pole on the higher bands. In his article [4], Peter, DL2FI, chose for his title the adjectival phrase "ein hochwirksammer DX-Vertikal" (i.e., "highly effective") with which I strongly agree.

Why call this a "Z-Pole" vs KF2YN's "C Pole"? Peter Zenker's vertical is a fundamentally different antenna because of the integrated toroidal matching transformer feed concept which primarily emphasizes the antenna's impedance which, in formulas, is designated "Z," also the first letter in "Zenker."

References

1. Produced by Walter Spieth, DK9SQ, in Germany and marketed in the U.S. by Kanga US (3521 Spring Lake Dr., Findlay, OH 45840. Around USD $100 - check Web site http://kangaus.com). Unlike the Black Widow and other such telescoping masts (I have not checked the MFJ 30m mast), DK9SQ's is entirely non-conductive so that a wire can be in physical contact with it and remain unaffected. Also, it is very sturdily constructed.

2. KF2YN used 3/4-in schedule-40 PVC pipe for the top and bottom spreaders as well as for the spacer in the gap between the two ends. For the EZNEC dimensions of versions for 20m, 17m, 15m, 12m, and 10m, see pp. 38-39. Note his warning that "the actual dimensions will vary from these" given in his Table 1. He noted also that his versions "for both 15 and 20 meters resonated too low in frequency and had to be shortened quite a bit." I doubt that the wood deck was the cause—it probably was the balun. A second caution regards KF2YN's statement "If your SWR meter indicates that the feed-point resistance is too high ...." This must have escaped proofing—an SWR meter simply cannot differentiate a low feed-point resistance from a high resistance or a resistance from a reactance. He must have meant "RX Bridge" or "antenna analyzer" such as those noted below.

Freq.	Resistance	Reactance
14.0	129	–j96.3
14.05	112	–j81.7
14.1	100	–j69.3
14.15	92	–j54.2
14.2	90	–j35.1
14.3	80	+j0.1

Table 2—20m impedances exhibited by the 40m version.

3. Actually, the primary of the transformer could be wound to increase the feedpoint impedance (more turns) to match to 300 ohms for ladderline on one band, plus multiband capability in high SWR low-loss conditions with a fairly short 300 ohms feedline. Another possibility was discovered by accident. I was connected to the 40m Z-Pole through my "modified for QRP" MFJ-941C tuner when I began transmitting on 20m. I was getting a slight "Reflected" reading, which led me to ultimately check which antenna was connected! That led me out to the Z-Pole base with the MFJ-202B RX Bridge which produced the following 20m readings (Table 2). These indicate a resonance at 14.3 MHz as well as 7.05 MHz. 72 ohms coax would match nicely at 14.3 MHz.

4. "Die C-Pole Antenne, ein hockwirksamer DX-Vertikal fur den portable Betrieb." (source forgotten) ●●

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There is Nothing Easier than "AltAir"

Oleg V. Borodin—RV3GM rv3gm@mail.ru

Figure 1—Oleg, RV3GM, (l) and Dick Pascoe, GØBPS, (r)—two stalwart proponents of minimal radios.

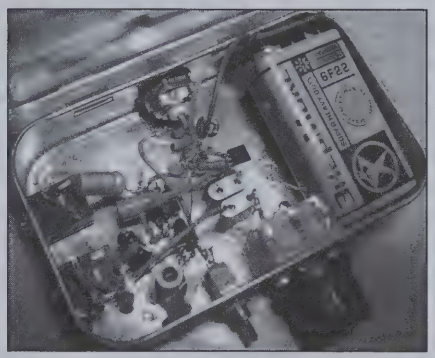

Figure 2—A view of the AltAir components and layout.

Figure 3—The complete AltAir station (less antenna).

Our Russian friend and QRP Quarterly *contributor, Oleg, has once again proven that minimalist radios can be a blast! With a small investment of time and just a few inexpensive parts, you can be on the air with this amazingly simple design.—Ed.*

What is "AltAir?" This is "ALToids on the AIR." AltAir is not a transceiver, but a DC receiver with a one-transistor transmitter sharing a common Altoids case (Fig. 2). Add a key, a 9v battery, and a simple antenna, and you have the tidy little station shown in Figure 3.

A two-gang variable capacitor is the only common component for the receiver and transmitter. Of course, they do share a common antenna and battery. There are no new or original designs in this unit, but the simplicity is evident from looking at the circuit diagram (Fig. 4). This little radio was built in two evenings only. It works at once and does not require any difficult tuning.

Looking at the circuit, you can see two variable crystal oscillators (VXO). One oscillator (Q1) is used for the transmitter and the other (Q2) is for the receiver section. Each oscillator has a 3579 kHz crystal, used in series with variable capacitor sections. Because each capacitor section has a different capacitance (60 and 160 pF), RX and TX VXOs tune to slightly different frequencies (approx 400 to 600 Hz). This gives me a real side tone in TX mode. I used an old military straight key with this radio. VXO shift is limited to not more than 1.5 kHz above the nominal 3579 kHz crystal frequency. Output power from the transmitter VXO is less than 200 mW to a dipole or 1/4 wave wire antenna with counterpoise.

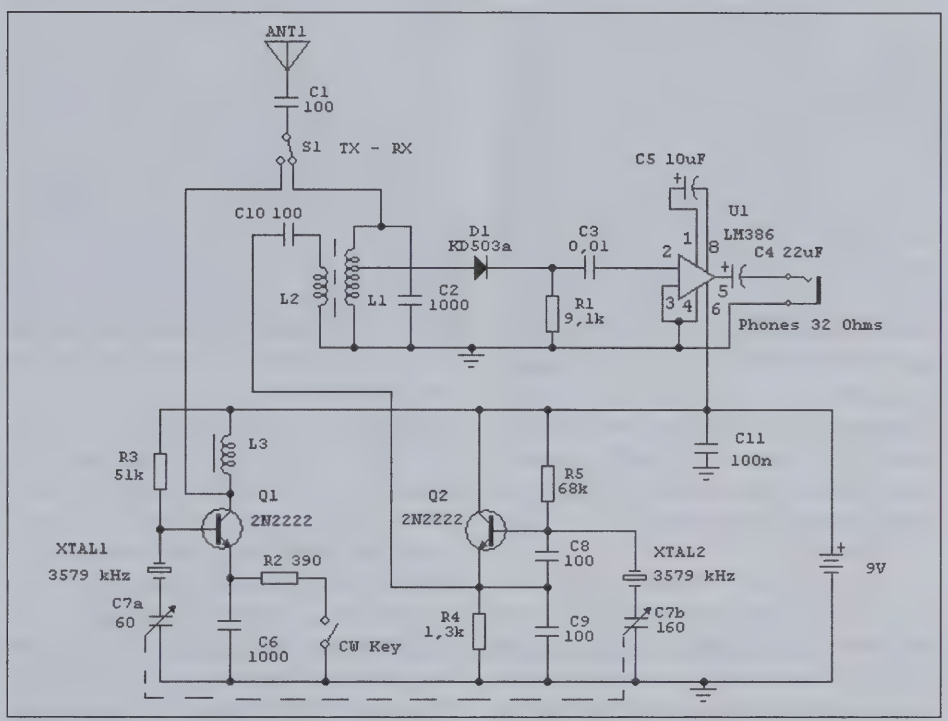

Figure 4—AltAir's circuit diagram.

The receiver uses a simple one diode mixer to mix the incoming signal with the receiving VFO. A 1N4148 silicon diode can be used here, followed by a simple audio filter formed from R1 and C3. The resulting audio is fed to an LM386 amplifier, which works well to "Philips" 32 ohms micro head-phones.

No doubt, this radio can operate on other bands with changes in crystals and LC components. For 80 m, L1 is wound on a plastic core with ferrite screw and consists 15 turns of 0.3 mm insulated wire. The coil is tapped at 5 turn from the antenna end. L2 is wound above L1 near "ground" end and consists of six turns of the same wire. RFC L3 is ten turns of the same wire on an FT37-43 toroid. I used "volumetric" or "dead bug" method of construction. Solder all ground connected components direct to the Altoids box.

I will be very glad to receive any stories and results from QRPers who will build this radio for 80 meters or other bands. Thanks in advance!

See you at QRP freq., 72!

QRP vs. A Flashlight

Jeff Smith—VE1ZAC jhsmith@ns.sympatico.ca

I work with a lot of science folks in a federal government laboratory. Some of them are aware of my radio hobby and occasionally ask questions about recent activities. I am never sure if they are just being polite, but I am always willing to give an enthusiastic response. I participate in the QRP fox hunts that go on Tuesday and Thursday nights. In the summer, it's Tuesday nights and the activity is on 20M only. So… this week, the answer to the question involved an explanation of the fox hunts and my satisfaction on finding both foxes in Texas and Colorado and working them to score points. I described how difficult it was, and finding them both was an accomplishment.

One of the science folks asked what the big deal was… a very short radio CW contact in the Southwest US? I thought about that a moment and said, "Look… it's 5 watts and very difficult conditions. Power wise, it's about the same as using a small flashlight, from the ground in Halifax, to communicate with a similar flashlight owner in Texas." Well, that generated interest and I promised to provide a quick analysis of my comment.

Here it is:

Let's start with the power. QRP, to the fox hunting crowd means 5 watts or less as measured at the output of you transmitter. That's not what is coming from the antenna, of course! I use a 2 element Yagi-Uda antenna made by Steppir that I can point in the direction of Texas. It has about 12 dB of forward gain, which means most of the energy (not all) heads in the direction I want and broadly illuminates an area that includes the intended fox location. I have about 100 feet of RG8X going to this antenna through a series of switches and protection gadgets, all of which rob some the signal from getting to the antenna. It's also safe to assume the antenna is well matched to the coax since the Steppir is continuously adjustable for just this purpose, among other things. Using a few calculators I estimate the transmission line loss is about 0.7 dB. I have lots of PL259 style connections to deal with, and estimate a further 1.5 dB loss because of them. Further, the antenna, as a transducer is not 100% efficient, and I estimate 0.7 dB loss in the antenna. (I will ignore the further loss of signal leaking out of the back of the antenna… but there is signal there, of course.) The total accumulated loss is approximately 3 dB. That means I have (maybe) 2.5 watts of energy to radiate towards Texas and Colorado. The flashlight analogy? Well, a bright flashlight with a modern bulb (non-LED type) can be in the 1 to 2 watt range. So let's say we take a flashlight and try and signal somebody in Texas with it. There are no terrestrial conditions where that is going to happen! (Maybe in the vacuum of space you could see the flashlight from that distance?)

Now, lets move on to the radio path to Texas. We need a little more info. The fox hunts always start at 0100 UTC, which means darkness in Nova Scotia and dusk in the Southwest. We are in a sunspot minimum and the solar flux conditions right now are about 66. This number is about as low as it goes. The geomagnetic field for this week was quiet, so that doesn't come into play very much. Our frequency of choice is 14.055 MHz. That is the upper end of the CW portion of the 20M amateur band. The distance to Texas, as the crow flies, is about 3100 km.

OK, what do we do with this stuff? Well, first off, we load up a program that can predict the ionospheric propagation for these conditions between these two points. There are all kinds of programs for this but an easy to use and free one is "W6EL Prop" from Sheldon, W6EL. You input the sun and geomagnetic data, the date and the "Terminal" locations, and it calculates a bunch of stuff based on a complex model used by governments and broadcasters to predict exactly these sorts of things.

The first thing it tells us is the maximum MUF (maximum useable frequency) for the entire day is 12.6 MHz, and that corresponds to 0100 UTC coincidentally. So, how come we are working on 14 MHz? Well, that is the band the QRP fox hunts work on, and that's that. The MUF being below us doesn't mean we can't communicate, it just means it's going to be hard, or might not happen at all.

Next, we look at the physics of the hops required for the trip, and it turns out we need two F layer hops to get our puny signal to Texas. That means we have to reflect off an ionosphere F layer, and then to ground, and back up and down again to make the trip. Each reflection weakens the signal further. Note that the ground can be bad to awful for reflecting, and the F layer isn't going to be a great help because of the low sunspot count and the low MUF. Anyhow, the software gives us a predicted receive signal strength from a typical 100 watt signal aimed at the receiving location from the specified transmitter location. In our case, it's "32 D." This means, upon investigation, 32 dB greater than 0.5 μV at the receiver antenna, and D means it is likely to be true only 1 to 25% of the time. In other words, the odds aren't good (propagation predicting is not an exact science). This connection works both ways of course.

Now we can add some other stuff. I know I am only getting 2.5 watts to my antenna. This is –16 dB from 100 watts. So, we know the POWER is reduced 16 dB from the signal referenced to 100 watts. Since the predicted signal level was 32 dB referenced to 0.5 μV with the 100 watt signal and a common receiver input impedance, our new predicted level is 32 – 16 = 16 dB referenced to 0.5 μV. (1 μV is one millionth of a volt… a pretty small signal.) This is a reasonable assumption based on the "System" input and output.

If we assume 0.5 μV is the same as a S meter reading of 0 (another reasonable assumption), then our signal from Halifax is expected to be about S2 to 3 on the receiver. (Assume one S unit is 6 dB… not always so). And, there is only a 25% chance, at best, of the signal being that good at the time we wish to operate. I can't speak for Texas last Tuesday night, but we had at least S2 of noise on the band, and it was very, very hard to pick out the signal from the other end. However, enough information was exchanged correctly to count as a completed contact (this isn't supposed to be easy!) And in fact, during the 1-1/2 hour operating period, I could only hear both fox stations at an intelligi-

ble level for, maybe, a third of the time. W6EL's propagation program was pretty accurate, it turns out.

Some statistics: We made a contact with 2.5 watts over 3100 KM. Therefore, the energy per km is 0.00008 watts. For a bright flashlight, one might be able to see it 10 km away under good conditions, which is 0.25 watts per km. The radio signal is 312 times more efficient!

Next time someone asks you what the big deal is in making a low power contact like this, tell them about the flashlight alternative! It's something most people will understand right away. Another interesting fact is that this contact was made without any expensive telecom infrastructure like fiber optics, copper wire, or microwaves being used. So the economic comparison is pretty lopsided as well.

This puts a new "Light" on low power radio communications!

Enjoy!

Jeff Smith, VE1ZAC

Note: the above is not a "Rigorous" analysis. It's more of a "back of envelope doodle" analysis.

●●

Now is the Time for VHF

Bob Witte—KØNR bob@k0nr.com

In recent months, there has been quite a bit of discussion in amateur radio and scientific circles about the sunspot cycle. Everyone seems to agree that we are at the bottom of the cycle, which means that we are all looking for some hopeful sign that the solar activity will start to increase. Some folks are predicting that the next cycle will be a big one, while others are raising the possibility that we might be headed into a sunspot drought. Someone once said that it is always darkest right before it really gets dark. The fact remains that solar activity has been darn near zero and poor propagation on the high frequency bands shows it!

The conventional wisdom for HF enthusiasts (QRPers included) is to focus more attention on 40M, 80M and 160M when solar activity is weak. In other words, run for the low bands. I'll accept that this is a very logical and reasonable strategy, but there is another one: try out the VHF and higher bands!

Here's the deal: none of this solar cycle stuff matters at VHF! (OK, that is not completely true, but the basic idea still stands.) So instead of fretting about how soon 10 and 15 meters will be open daily with awesome worldwide DX, spend some time playing with the VHF bands.

A Different Challenge

First off, I need to admit that you probably aren't going to get DXCC using QRP power levels at VHF. Even if you run a kilowatt, it isn't likely to happen. Just getting Worked All States is a major accomplishment on any of the VHF bands. So we need to get calibrated on the level of challenge involved in using these bands.

Figure 1—Chris, KØCAO, operates from the summit of Columbia Peak in the 2008 Colorado 14er Event. (Photo: KØCAO)

Figure 2—Joe, KXØY, is operating from the summit of Snowmass Mountain as part of a winter ascent in January 2008. This required a serious mountaineering effort with snowshoes and skis to reach the summit. (Photo: KXØY)

Usually, we talk about VHF and higher propagation as being line of site. This is an oversimplification, as VHF contacts are made every day that are beyond the horizon. With VHF and higher frequencies, without any special propagation or high elevation, we are looking at communicating only 20 to 30 miles with very basic equipment. Put a good antenna high up on a tower and you can extend that range further. Adding some gain to the antenna also stretches the performance. And now you see The Different Challenge: stretching the ability to communicate from a mere 20 miles to something more like 200 miles (or even further). Even 200 miles is a short distance by HF standards, but the challenge on VHF is fundamentally different.

One of the cards we have to play is the careful choice of location. Many HF QRPers like to take the field to enjoy radio operating in remote locations. We can apply this same approach with VHF QRP, only we are going to be focus a bit more on elevation, or more specifically height above average terrain (HAAT). Increased height (relative to everything around us) gives us a direct benefit on VHF and higher bands. The classic example is operating from a mountaintop that towers over the adjacent terrain, providing thousands of feet of elevation gain.

My home is in Colorado, so I am fortunate to have a nice set of mountains in my backyard. However, if you look around North America, even the so-called flatlands are not all that flat. There is variation in elevation that can be used to your advantage on VHF. Figure 1 shows Chris, KØCAO, operating at the summit of Columbia Peak (above 14,000 feet) in the Colorado 14er Event. (For more informa-

tion on the event, see the VHF column in the Summer 2006 issue of *QRP Quarterly.)* The mountaintop fun is not limited to just the summer. One of our more serious ham mountaineers is Joe, KXØY, who has been doing winter ascents of the Colorado mountains and taking VHF ham radio along (Fig. 2.)

Propagation

There are number of propagation modes that can help us make contacts over long distances. (Entire books have been written on these topics, so I will only touch on them lightly here.) Sporadic-e skip is a common but unpredictable propagation mode that supports skywave propagation on 50 MHz, 144 MHz and sometimes 222 MHz. Sporadic-e is what makes 6 Meters the Magic Band during the summer months. The typical pattern starts with 50 MHz being dead quiet except for some local stations. Suddenly, you start hearing stations coming in from 800 miles away. The intensity of the signals builds rapidly and you know that they can disappear just as fast—so you work them as quickly before you lose the opportunity. Sometimes the band stays open for hours, sometimes it folds quickly. When sporadic-e is intense, 144 MHz may also open up (and occasionally 222 MHz.)

During the Colorado 14er Event in August, we had some excellent 50 MHz e-skip into the southeastern part of the country. Not only did we have the advantage of HAAT, the sporadic-e allowed the mountaintop stations to work across the country.

Tropospheric ducting is another common form of propagation, quite common in many parts of North America. (This is one propagation mode that we don't experience much in Colorado.) Basically, layers of warm and cold air set up a duct that allows a VHF signal to propagate for hundreds of miles. This mode is also not especially predictable, as it tends to show up unexpectedly creating great DX fun for an unknown period of time.

There are other VHF propagation modes such as aurora and meteor scatter, which I won't cover here. You can see the basic theme here: compared to HF propagation, VHF DX is much less predictable, which is precisely the reason it is so exciting. Making VHF DX contacts is all about preparation and patience…with the likelihood that on any given day you will end up disappointed…or you may snag some DX.

Figure 3—Steve, NØTU, has combined backpacking with his pair of goats and QRP radio operating. Here he is at the trailhead to Uncompahgre Peak with his goat named "Peanut." (Photo: NØTU)

Blended Activities

In general, QRP operating finds its way into blended activities. Think about the "trail radio" enthusiasts….are they out to enjoy the outdoors or to enjoy radio operating? The answer is "Yes to both." It is a blended activity that allows them to enjoy the outdoors while still playing with radios. The same is true for the Colorado 14er Event…it blends hiking/climbing with the ham radio hobby.

One of our local QRP enthusiasts, Steve, NØTU, has combined his love of backpacking with his love of QRP operating (Figure 3). His unique spin is that his two hiking companions are two goats named Peanut and Rooster. (Steve calls himself the Alpha Goat.) Not only that, he maintains an excellent blog complete with videos that capture the adventures of the Old Goats QRP Team (see URL below). Steve has been very active on the HF side of QRP, but he has been doing more VHF work recently...including the ARRL VHF contests and the Colorado 14er Event. All of these with his buddies Peanut and Rooster along to help carry some gear and keep him company.

For the ARRL September VHF QSO Party, I decided that a traditional contest effort wasn't in the plans. But I did have this idea of exploring some new Jeep roads in the San Isabel National Forest near Leadville, CO. This area was also likely to be a good radio contesting site (what a coincidence!), so I took along the FT-817 QRP rig and my Arrow dualband antenna (Fig. 4). Using just 5 watts to the short Yagi, I was able to work WØEEA about 105 miles to the east on 144 MHz and 432 MHz SSB.

Figure 4—Bob, KØNR, preparing to operate from the side of Quail Mountain in the San Isabel National Forest in the September VHF QSO Pary. Note the Arrow yagi antenna resting against the Jeep wheel. (Photo: KØJJW)

Give VHF a Try

There is a lot of challenge and fun waiting for you on VHF. If you look around your ham shack, you might already have a rig that is VHF capable. In recent years, the equipment manufacturers have included 6 Meters (and sometimes 2 Meters and 70 cm) in their HF rigs. Of course, the FT-817 is a great little QRP rig that supports HF through 432 MHz. I generally recommend that you get on the air when you know there will be local VHF activity, by checking into a local VHF net or operating on a VHF contest weekend. Go out and find your local "high spot" and give yourself some height advantage…it makes a big difference on VHF.

72, Bob KØNR

References

1. Colorado 14er Event: http://www.14er.org

2. Steve NØTU's Blog: n0tu.blogspot.com

3. ARRL September VHF Contest: http://www.arrl.org/contests/rules/2008/sepvhf.html

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The RAMU (Remote Aerial Matching Unit)

Ian Keyser—G3ROO; Ron Taylor—G4GXO

This is the cumulation of a years work, mainly by Ron of Cumbria Designs, to get a system working that I have always thought would be an asset to radio amateurs. So often we wish to control R, C, or L remotely, and sometimes L and C together to create a matching circuit. Auto Aerial System Matching Units (ASMUs), will do the latter, but lack the versatility of the manual system described here and also lack the ability to control resistance. Last year, at the Rochdale convention I ran the idea past Ron and he volunteered to have a look at it "in his spare time." I think that it has taken a lot more than his spare time, mainly due to me moving the goal posts during design! The result is very rewarding allowing remote control of switched L and C values over at least 150 ft. of cheap LAN cable. The RAMU is shown in operation as Figure 1.

Figure 1—The RAMU in operation.

Circuit Description

The RAMU comprises two parts; a control unit and a remote "head unit" (see Fig. 2). At the heart of the RAMU control unit is a PIC 16F877, which scans the controls, responds to changes, updates the LCD, formats control data words and sends them serially to the remote head end. The control unit features two rotary encoders for emulating rotary controls (such as variable capacitors, inductors or pots), four push button switches for user set up and auxiliary controls and a 16 × 2 line LCD for displaying settings and unit status (see Figs. 2 and 3). Communication to the remote head end is by a serial format over a five wire interface; two for power and three lines for serial data. The remote head end converts the received serial data stream into relay operations which can be used to provide incremental changes in R, L, C or anything else that you may wish to control remotely. We have also made provision for control of four additional relays in case your application requires more control. These "Auxiliary Outputs" are selected by two of the front panel buttons (see Fig. 4).

The head unit consists of a shift register to convert the serial data to parallel logic outputs which drive relays. Each serial data channel provides control of 20 relays arranged in two groups (10 for L, 10 for C) and four auxiliary outputs. Each relay group is used to switch lumped constants providing 1000 combinations. For example, if combinations of capacitors were switched by the relays in the sequence 1, 2, 4, 8, 16, 32, 64, 128, 256, and 512 pF a very accurate 1000 pF variable capacitor having a resolution of 1pF could be simulated. Using inductors of 0.1, 0.1, 0.4, 0.8, 1.6, 3.2, 6.4, 12.8, 25.6 and 51.2 µH a variable inductor between 0.1 µH and 100 µH, plus strays, is available. Of course, more than one "capacitor" or "inductor" may be used in any matching circuit; with the RAMU you achieve this by using another relay board and driving it in parallel with the first. You can even make a differential capacitor by putting the capacitors in reverse order on the second board. Alternatively, with slight changes to the software and at the expense of slower data rate, relay boards could be cascaded serially to "expand" the outputs available on a channel.

Operation

There are two modes of operation; Setup and Operate. In Setup the controls are used to configure the key functions of the RAMU such as rotary encoder step sizes. Once complete, all settings are saved to EEPROM within the PIC and are recalled when next switched on. In Operate mode the operation of the controls is interpreted by the PIC to produce serial data words, which are sent along the cable to the head end where they are converted into a series of parallel outputs which control the relay states.

In Setup, the four control unit push buttons are used to program the step sizes by range allowing a progressive "tuning law" to be introduced. It is possible to setup the RAMU to "tune" the capacitor or inductor outputs in unit steps from 0 to 1000. This would correspond to steps of 1 pF from almost ZERO (stray capacitance of the relay circuits) to 1000 pF. While a 1 pF resolution is great up to say, 100 pF, 1 pF steps at 1000 pF make little change and would make it time consuming to go from 0 to 1000 pF. For this reason the option to program in a "tuning law" is provided to match the tuning rate to the total L or C value. The tuning law allows the RAMU to use greater incremental values of capacitance or inductance at the high tuning ranges. For convenience five ranges have been chosen against which incremental steps of L or C can be programmed:

Tuning Count:	0-63	Step size 1
	64-127	Step size 2
	128-255	Step size 4
	256-511	Step size 8
	512-1000	Step size 16

Both channels use the same tuning law as it was considered an unnecessary complexity to program each individually. The control unit is able to control marc than one head unit. The data stream is passed to all heads in parallel, but the only unit to respond will be the unit whose latch line is held high. This is done with a simple rotary switch on the front panel of the control unit. The uncontrolled units will maintain their settings for as long as power is applied. In my unit I am maintaining power to all heads even when the station power is turned off, therefore removing the requirement to retune every time when going on air.

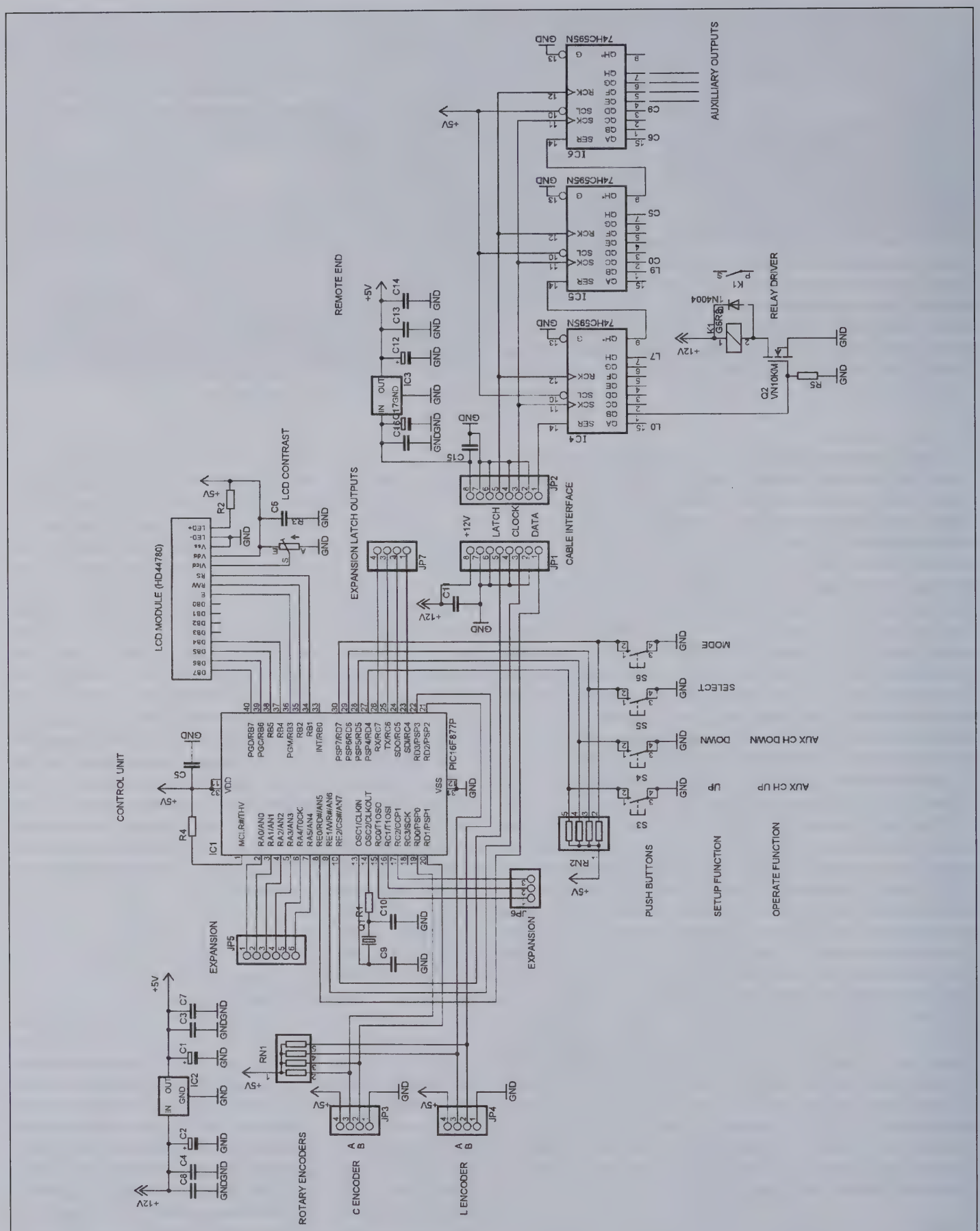

Figure 2—Remote Aerial Matching Unit (RAMU) schematic.

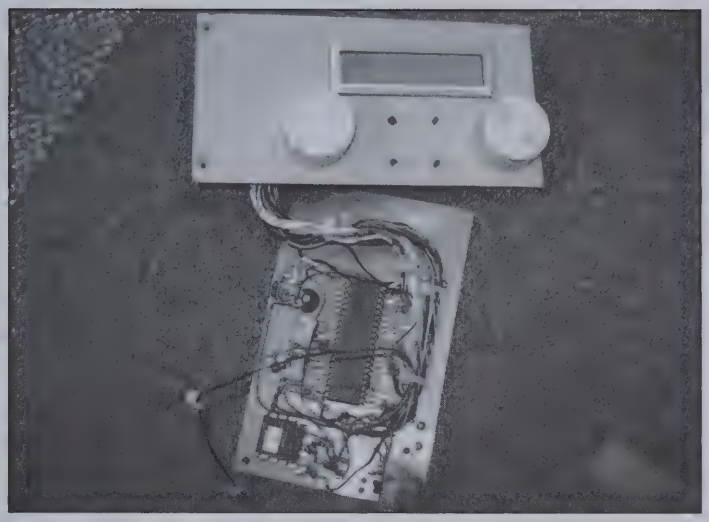

Figure 3—RAMU control board.

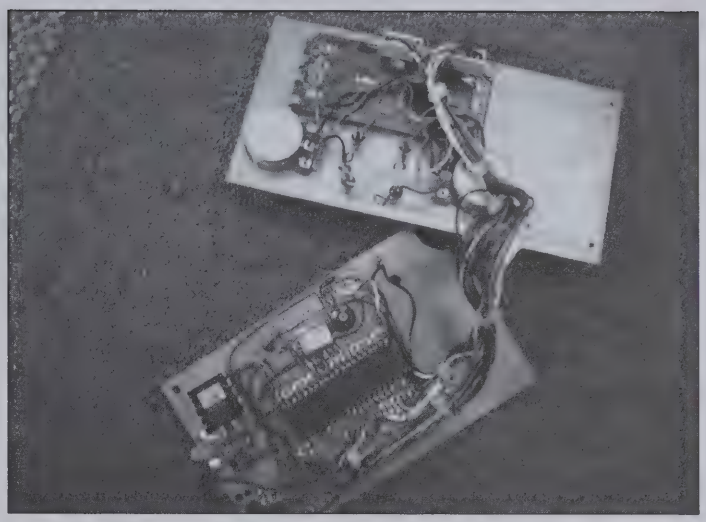

Figure 4—RAMU control board—back side.

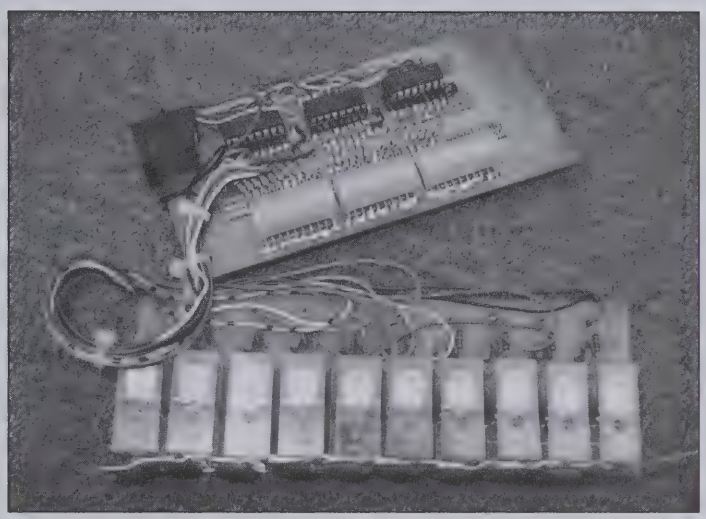

Figure 5—RAMU "C" board ("Remote Head Unit").

Components

I have been experimenting with high voltage capacitors and have found the best are made using short lengths of coax. For QRP, silver mica capacitors are fine; for 100W RG76 cable can be used, but for really high voltage applications RG67 would perhaps be a better choice. However, if you do have a burnup it is a simple matter to cut another length of cable! Since this article was written, a company (TAB Components Ltd.) has advertised in *Radcom,* Sept-07 p. 87, the ideal capacitors. See http://www.tabmica.co.uk.

A capacitance and inductance meter greatly simplifies component selection and set up. For ease of use you need a "real time" meter. The "PEAK" meters, although excellent, make life difficult and slow. On eBay from time to time "J11" inductance and capacitance meters are available... I bought mine when they were about £12, but now I see that they start at £17; still an excellent buy, though. While these meters are thirsty on batteries, they are a very useful tool and can be powered by 12v for bench use.

Future Development

The source code is provided free on the G-QRP Web site (http://www.gqrp.com), and extensive line commenting has been provided to clarify the program operation and encourage development and adaptation. The software is highly modular so that blocks of code can be easily "lifted" as required and used in other projects. In the interests of clarity the program flow has been kept simple, at the expense perhaps of some efficiency, making it a useful source of self-tuition material for PIC assembler language programming. The choice of the 16F877A for this project, with its range of useful internal peripherals and large number of I/O lines offers considerable flexibility and scope for future development. A glance at the circuit diagram shows that there are still a good number of spare I/O lines available, some of which have an analog capability. There are several clear development opportunities which would further enhance the RAMU:

1. Memories for storing and recalling tuning settings.
2. Variable length tuning words to accommodate longer relay "chains" in the head unit.
3. Variable rate tuning as an alternative to fixed law tuning.
4. An automatic setting for antenna matching. This could make use of the PORTA analog inputs and a VSWR sensor at the Control Unit end. Past settings would be stored against a frequency value (say 100 kHz resolution). On auto tune, the RAMU would first measure the transmitter's frequency then check to see if there are any stored settings held. Any settings would be applied, and a fine tuning routine would attempt to improve the VSWR. If no settings are held then the RAMU would start from scratch using VSWR measurements.

If you develop the RAMU software to include these or any other features that add useful functionality, please submit it to the club for publication on the Web site. We ask that the program is kept as a single ASM file to simplify distribution and compilation.

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How Do Projects Start?

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Over the years, I've built a metric ton of stuff! I even make a living at it. But the question I get asked on more than one occasion is "How did that project, or any project, get started?" and, "Why did you build it the way you did?"

There is rarely an easy answer to those questions. I've had projects or designs start because someone gave me something. Or, I found something that I needed for a project I'd been thinking about for eons. Or, my favorite answer—just to see if I could. But none of these are real answers. Often there is a long series of things along the way and only the result becomes visible. So, some examination of that process is worth taking a look at.

Part Insanity, Part Need

I often joke that engineering is part insanity and part need. The "insanity" part is wanting something that may be unavailable or way out of reach. The "need" is easier to see, since often the desire is for a specific thing. But most of the time, what really happens is:

- I wanted X, and
- Along the way I had to build Y, and oh yes, Z
- As they were needed to test Q, which was the core of X.

Some of my first big projects happened exactly that way. For instance, long ago I wanted to build a sine wave oscillator, and to really look at the result of that project I needed an oscilloscope. Well, a scope cost many dollars and I was young and had few. So, I decided to build an oscilloscope. What was the oscillator for? To evaluate audio amplifiers. That was a typical project then. What the project was really about was learning—learning patience, as well as what tools are needed to perform a task, and what order they might be obtained or built to support that task. That, and learning a whole lot about oscilloscopes and what 1500V feels like!

After many trips to the Lafayette Radio and Harrison catalogs, looking for what was always out of stock, I decided that the solution was a trip to Canal St., NYC—the electronic surplus and junk Mecca, back then. There was this thing with a scope tube in it. It had all the bits, but wasn't a 'scope. But more importantly, it was in the budget. I think it was some kind of early blind landing display from early 1950s bombers. So off I trundle with 20 pounds of iron, glass and aluminum to the subway train and home. A trip to the library got me a book that had an o'scope circuit. With circuit diagram in hand, I proceeded to strip the chassis and wire this gadget up. Much metal work, and many shocks and whatnot later, this effort yielded a basic oscilloscope that worked.

Skip to modern era. I've long since built the basic requisite bench and populated it with a modest assortment of the most useful basic test tools. Fundamentally, projects work now as they did then. A need becomes a process that results in various bits being built. And somewhere at the end, a visible result emerges. Everyone sees the result, but not the path to it. I've long since embraced the process because, as they say, getting there is half the fun. It is an exercise in being fearless. This does not mean grabbing the B+ like it can't hurt me. By the way, it really does hurt! It's about those things that seem so complex, yet when broken down can be understood entirely and therefore buildable. It's far easier to understand a single transistor amplifier than a board with many of them. Yet once you understand the one, the many are just a lot of variations of the same old thing. Computers are a great example of many simple things repeated to the extreme.

Everyone sees the result, but not the path to it. I've long since embraced the process because, as they say, getting there is half the fun.

The Project Process

So, what's the process? Simply put, it's study. It starts with a spark—either something I have, bought, found, or was given that has "potential" as part of a greater project. It might be a filter, some old low voltage tubes, maybe a box of random parts, or an assembly like KK7B's MiniR2 and MiniT2 phasing SSB subsystems. Then, I dive in to how it works and why, and then start looking at how I can best exploit it as a subsystem or component as part of something more complete. When that comes together, a project happens. That set of events is the birth phase, and through out the projects life and often afterwards, the process will reoccur as changes or improvements.

I move along throughout a project, trying to figure out how to assemble it, house it, and find all those bits and pieces that make it complete. This is where the "well stocked junkbox" comes in. The junk box is actually a large parts stock of things I commonly use, like common value resistors, diodes, capacitors and many more items. It's also literally boxes of junk, boards with salvageable parts, subassemblies, and even old projects that never made it or got retired. In every case, it's raw material. Engineering is converting what you have into what you want. I try to have a lot of stuff so when I build something, the right part may be there. As a result, I have a lot of old and oddball parts. But, they sometimes come in very handy.

Another part of the process is that a lot of paper gets stuff scribbled on it in the form of possible schematics that will accomplish a given result. Actually, I use engineering-style bound graph-paper notebooks, where everything is done in ink and errors are crossed out with single lines. Why? It's the process. Save all the work, both good and bad, as effort is already invested and reusable. You never know what will help at a later date. Even when the project never makes it to completion, some of the component stages may be just what I am looking for when combined differently. And, by the way, documentation includes "as drawn" schematics, with notes on "as built." The latter is important because it documents what was actually done, for reasons like if it ever stops working, or so I can build another the same way. It also covers the cases where some part became unobtainable and I have to build around it. That happens a lot. So, often the basic design morphs from that really fancy

IC that does it all so well, to a pile of transistors, or maybe a different IC that turns out to be better. The reverse also happens. Rather than do it yet again that way, I may find a better, cheaper, easier solution to build that screams "Try me!"

An example of why this documentation is a good thing happened a few years ago. I decided that I needed to get a bit more punch on 6M, as my 20W didn't always do it. It was obvious that 100W was the next step, and I began to search around for designs and what parts I had and available. I was influenced by the MRF247s I had laying around from a 2M repeater maintenance project. If they were good enough for 2M, why not try them at 6M? A *QST* oldie article for a solid state, 6M "brick" popped up, and even the board for it was available from FAR Circuits. However, I wasn't going to use the MRF492 called for in the original design. After scouring the datasheets and realizing this was uncharted ground, I figured why not build it and see. Which is what I did. I assembled it, boxed it up in an old really nice aluminum A/B switch case, and used a really huge CPU cooler for a heat sink. When it all was done, I dubbed it the Junque Box Special.

Everything but the circuit board used in the Special was from the junk box. It worked, though I had to refine the circuit as the transistor was clearly not what the original designer had in mind. It took a bit of extended testing to finally settle on what was a winning arrangement for the critical input and output networks. In the end a collection of castoffs became a nice solid 100W brick that gives the 5W mobile rig [an earlier project] a near-60W bark when needed. It's small enough to hide under the seat, and doesn't get near being overdriven. So, it gets rave reviews. Everyone sees the result of this project, but maybe not the process. What went on before is a lot of reading and understanding about how high power transistors of that type wanted to be fed. Lots of basic measurements with simple gear allowed me to study the efficiency and stability of the amp while verifying it was linear. The result was a lot of notes and cross outs. Fun, too.

Now, I'm thinking about another project. I live for 6m, but I also like to work SSB HF at low power. I have two QRP SSB radios I built for 10m and 20m to satisfy the HF need, and also a restored HW-101. But every so often, I'd like a smaller radio for 40m or maybe 17m and I don't have one. So, I've been dabbling in my notebook on how to do a SSB and PSK31 radio that might cover 40m, 17m, and maybe other bands. When I started with the idea, I was going to do a straightforward filter rig. Then, I got the KK7B MicroR2 and MicroT2 kits and, well, the ideas are doing the process thing again. I haven't yet arrived at something I will build. I'm, still making notes on paper to see what I want the radio to do and how I will approach the myriad ways to do it. Some things I have decided on are QRP output power, battery capable and small size. The process to get to the end will be the same. I've built and tested the MicroR2 and T2 pair, and built few different transmitter power chains as experiments. There are items like VFO, DDS, or PLL for main tuning to consider, or maybe even a mixture of those things. The HW-101 showed me, by not having one, that there is value in dual VFOs or some other means of operating split. Then, there is the question of band switching relays or a really large switch like older radios used. Of course, there is the question of whether adding intelligence in the form of PIC microprocessors, like Elecraft does, buys me anything. There is also the question of "Has it gotten so complex that the time to build it exceeds my free time by several orders on magnitude?" These questions and more, plus the usual "unobtainium" problems and budgetary considerations, will have some influence on the result. As they say, stay tuned.

So, now you see what really happens when a project is kicked off and you decide to build something yourself. I revealed what happens for me, in part. Each project is different, as I also build non-PC based computers from scratch. But they all share a common process and all the usual and unusual problems that occur along the way. Among the usual problems is getting that part, IC, or transistor that is now out of stock or gotten amazingly expensive, that is where going back to the drawing board happens. Occasionally, the unexpected happens where a substitute works better or horribly worse. I often joke that every project is a prototype, proof of concept, or the collusion of serendipity when it works. But somehow the process always has its way and all of the twists and turns result in a project. And, remember, every project is a good thing, regardless of how it turns out. At the very least, you will gain some experience that will be valuable the next time.

So you want to build a radio, hmm? Go for it. You are about to do something very few people do.

■■

Have you analyzed why you did your last project? Was part of your motivation to show your fellow QRPers and homebrewers what you have done?

Publish your results (and the story of your process) in *QRP Quarterly*!

Share your success! We know it will help encourage others to gather the necessary parts, get out the tools, heat up the soldering iron and make something work (eventually).

Send article ideas to Ted, KX4OM at: editor@qrparci.org

A Six-Meter SSB Transceiver

Harold Smith—KE6TI harold.smith1@gmail.com

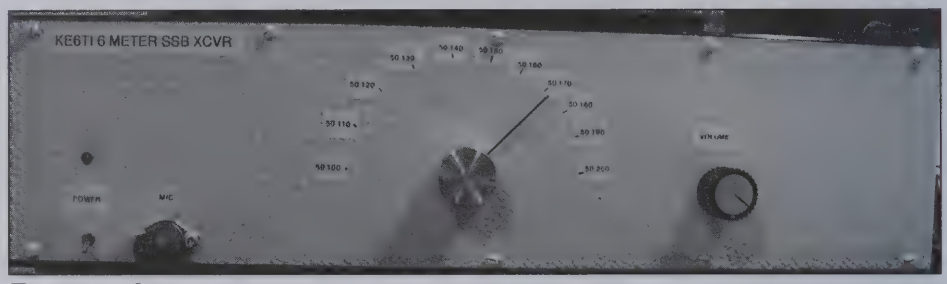
This is a homebrewed six meter Single Sideband (SSB) transceiver. It is built almost entirely ugly style, except for the W7ZOI Hybrid Cascode kit that is the IF and AGC circuitry. It uses a conventional superheterodyne/filter architecture in both the transmit and receive sections. This radio came about after some discussions with Ted Bruce, KX4OM, the hard-working editor of this magazine, who was looking to push six meter activity, and it gave me the chance to try some things I had wanted to try anyway. As much as possible I used what I had in my junk box, so this may not be something anyone else could duplicate exactly. I did purchase the IF amplifier module.

Refer to the included photos and schematics for reference. Frequency control is by means of a Super VXO, which is a variable crystal oscillator that uses two crystals in parallel to get a wider tuning range. The oscillator tunes downward from the 20.5 MHz crystal frequency. The output of the SVXO feeds a frequency tripler and band pass filter, the output of which is approximately 60.5 to 60.4 MHz. Combined with an IF at 11.289 MHz, the radio's tuning range is precisely 50.1 to about 50.2 MHz. The SVXO's frequency range has been adjusted, by compressing or expanding the turns on the SVXO coil, so that out of band operation cannot happen. A splitter gives two equal 10 dBm outputs to feed transmitter and receiver.

A VXO is not always the most convenient means of frequency control, but this degree of stability would be very difficult to achieve with a VFO, especially at 61.5 MHz. This VXO shows only slight range nonlinearity from one end to the other. The frequency is controlled by one section of a variable capacitor from an FM tuner, which includes a reduction drive. Tuning rate is about 100 kHz per turn, adequate for six meter SSB.

The receiver starts with a lowpass filter and image trap, followed by a 3N204 dual gate MOSFET RF amplifier. The mixer is a packaged diode ring double balanced type, buffered by a 2N5950 common gate JFET stage. The radio's primary selectivity is next, a six crystal LSB ladder filter with a bandwidth just under 3 kHz.

The SVXO (Super VXO).



Front panel.

After the crystal filter is the W7ZOI/WA7MLH Hybrid Cascode IF/AGC board. I built this from the kit offered by KA7EXM, with only a slight modification to put it on 11.3 MHz.

After the cascode board is another crystal filter, this one with four crystals, which helps eliminate wideband noise from the IF, as well as improving the overall skirt selectivity of the radio. Next is the product detector, another diode ring. The BFO is part of the exciter module, and is shared with the transmitter. There is only a single BFO frequency, thus there is no provision for Lower Sideband or CW operation.

After the product detector is another common gate 2N5950, and a four pole Sallen-Key active low pass filter implemented with MPS-A14 Darlington transistors.

After the low pass filter is the volume control, and the audio power amp, a TDA2611A integrated circuit PA which can put out over a watt of audio with a 12V supply. There is a jack for a speaker on the rear panel.

The transmitter starts with a microphone preamp and a Sallen-Key lowpass filter. The mic preamp includes provision for powering an electret microphone. The balanced modulator is an MC1496 integrated circuit. The venerable 1496 does a great job as a balanced modulator, but its pinout is such that building it, ugly style at least, involved a number of leads crossing above and below one another.

After the balanced modulator is a six crystal filter, identical to the one in the receiver. I had a good supply of crystals, and a separate filter makes T/R switching much easier than it would be if I had to switch a filter back and forth. There is a buffer after the crystal filter, and then the transmit mixer, another packaged diode ring mixer.

The BFO is above the crystal filter's center frequency, so the signal generated is Lower Sideband, but the SVXO is above the output frequency, so sideband inversion occurs in the transmit mixer, giving Upper Sideband output, which is the convention on six meters. The transmit mixer is also buffered by a common gate JFET, which drives four bipolar transistor amplifier stages. The transmit filter is embedded within the amplifier string.

The final amplifier is built around an NTE235 bipolar transistor, specified to have a 200 MHz F_T and 5W output to 50 MHz, which it appears to be capable of. The final is operated in class AB, with a

standing current of about 100 mA, and includes a substantial heatsink. After the power amplifier is a 7 element low pass filter and the antenna changeover relay. The BNC antenna connector is on the rear panel.

Transmit-receive switching is accomplished by a combination of relay and circuitry. A relay switches the antenna, and transistor switches route power to transmitter or receiver. The oscillators are always powered, of course. The radio is designed to operate on 12 to 15 volts DC, and reverse polarity protection is included.

The cabinet originally housed a dual cassette deck, which had died by the time I acquired it, so I upgraded it to hold a radio. I had to fabricate a new front panel to replace the original that was mostly holes. I had originally intended to put this radio into a somewhat smaller cabinet, but it just kept growing…

I built the radio over more than six months of occasional evenings and weekends. I tried a lot of things that did not work very well, and that I had to do over, but I eventually got it working well. The SVXO / tripler was one of the things that worked right, first time. On the other hand, the transmit driver stages were rebuilt more than once.

One subtlety that may not show in the schematics or photos is that I tried to avoid ground loops in interconnecting modules. The packaged diode ring mixers are transformer coupled internally, and I did not ground the coax bringing the signals to the mixers at both ends. Instead I grounded the coax shield at only one end, and did not ground the mixer end. I do not know if this helped or hurt anything, but it appears to work. In fact, anytime I had a transformer output or input to a module, I grounded the coax feeding to or from it only at the non-transformer end.

Details:

- Super VXO (two crystal) frequency control, 50.1 to ~50.2 MHz, USB
- SVXO frequency 20.5 MHz, tuning down, tripled to 61.5 MHz
- 11.289 MHz IF, high side injection.
- SVXO range adjusted to just hit 50.1 MHz, to eliminate danger of out of band operation.
- Built Ugly Style (obviously!) in several modules over several months

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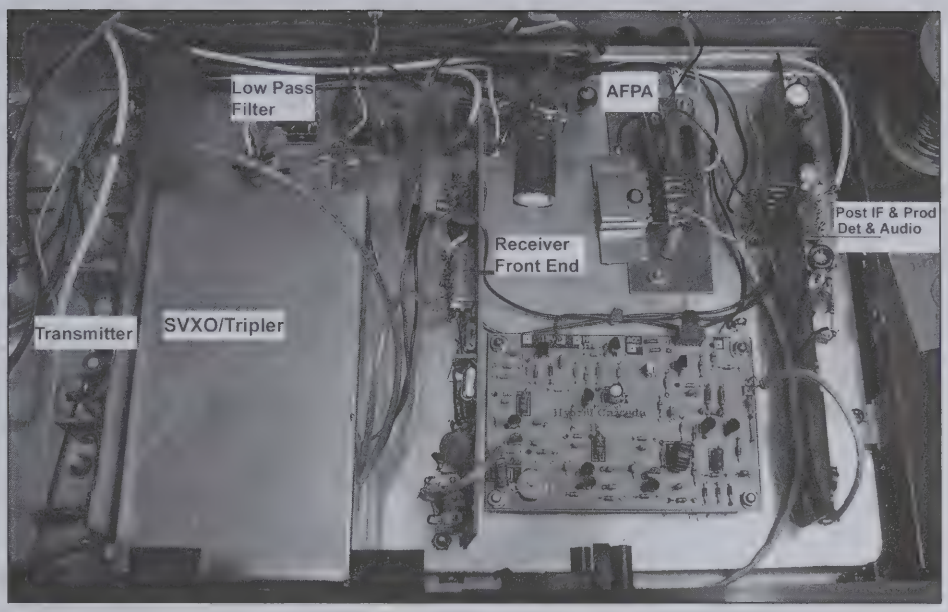
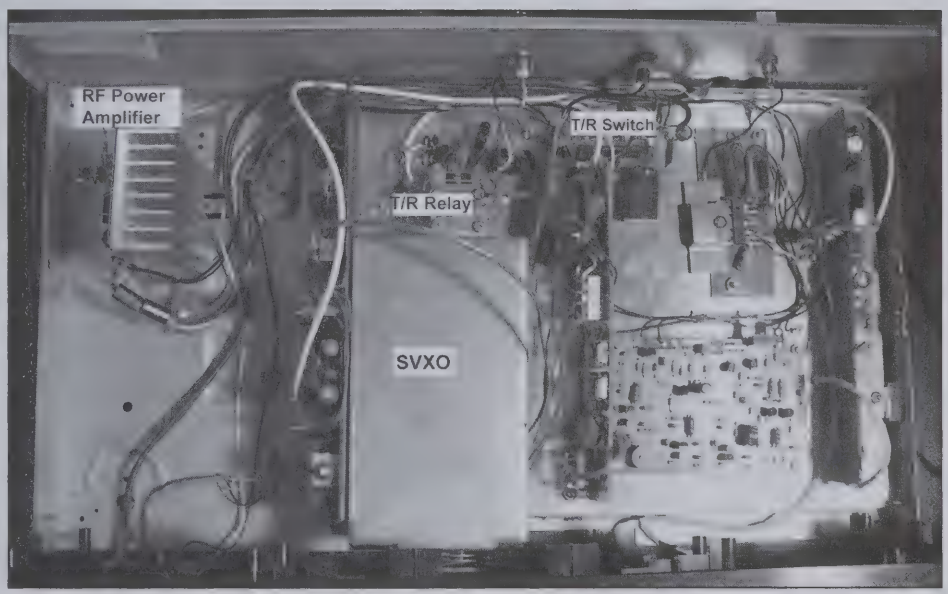
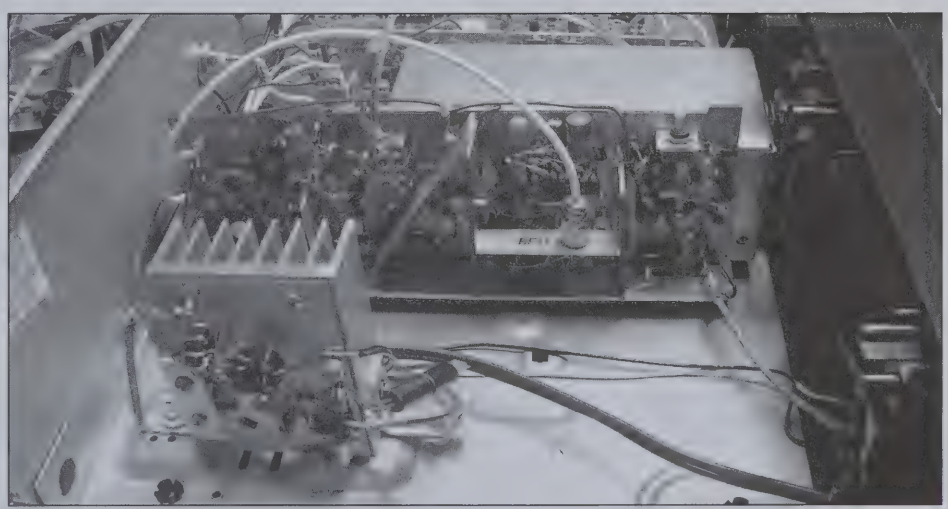


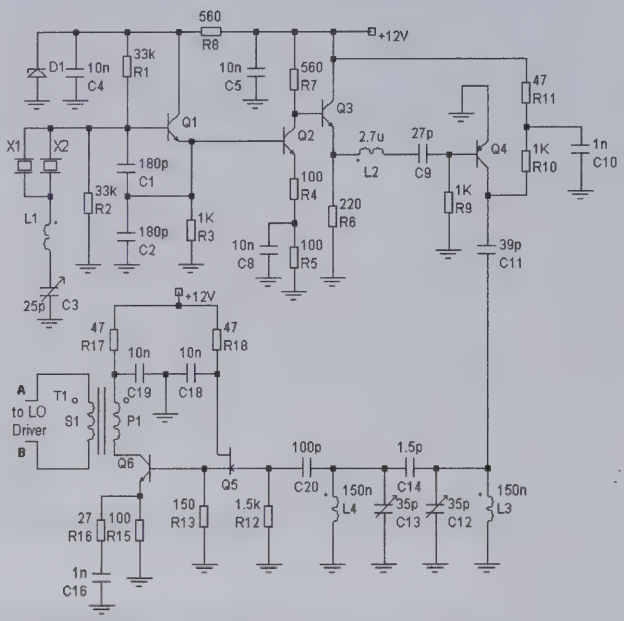
Overhead view.



Another overhead view.



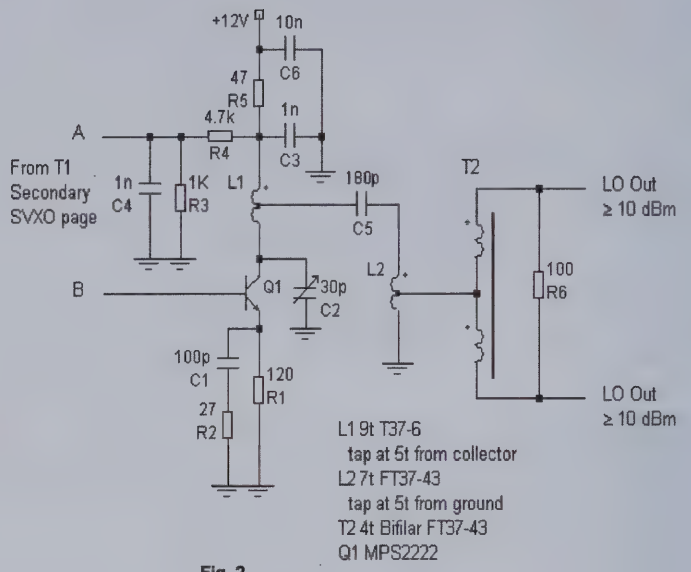
XMTR picture.



All NPN MPS2222
Q4 2N2907
Q5 2N5950
L1 40t T50-6
L2 2.7 uH molded choke
L3, L4 7t T37-6
T1 5t Primary, 1t Secondary FT37-43

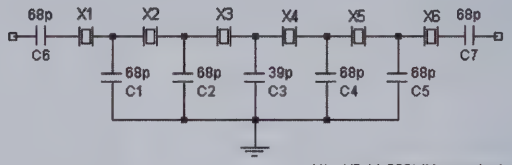
D1 7.5V Zener
X1, X2 20.5 MHz Crystals

Fig. 1
20.5 MHz SVXO, Tripler, Filter



L1 9t T37-6
tap at 5t from collector
L2 7t FT37-43
tap at 5t from ground
T2 4t Bifilar FT37-43
Q1 MPS2222

Fig. 2
LO Splitter-Driver



X1 - X5 11.289MHz nominal
matched to < 100 Hz

Termination Impedance 250 ohms

Fig. 4
Crystal Filter

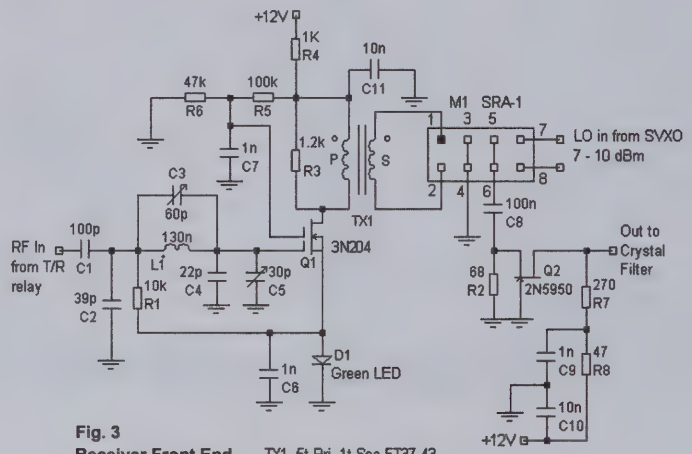


Fig. 3
Receiver Front End TX1 5t Pri, 1t Sec FT37-43

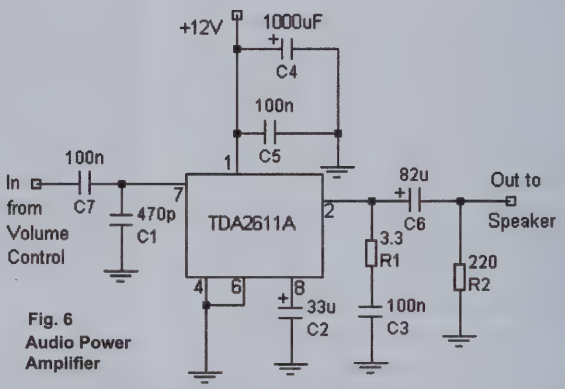
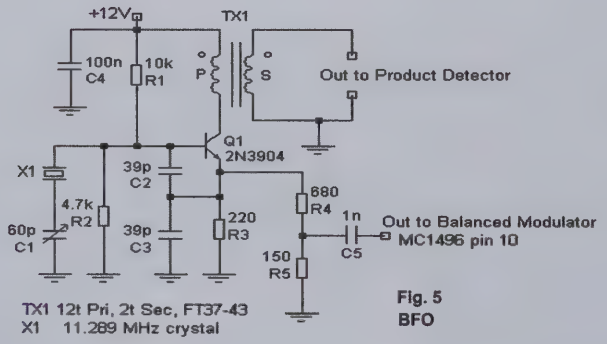
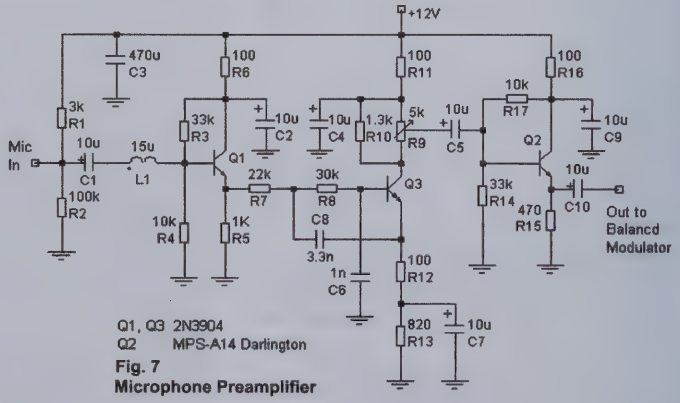


Fig. 6
Audio Power Amplifier



TX1 12t Pri, 2t Sec, FT37-43
X1 11.289 MHz crystal

Fig. 5
BFO



Q1, Q3 2N3904
Q2 MPS-A14 Darlington

Fig. 7
Microphone Preamplifier

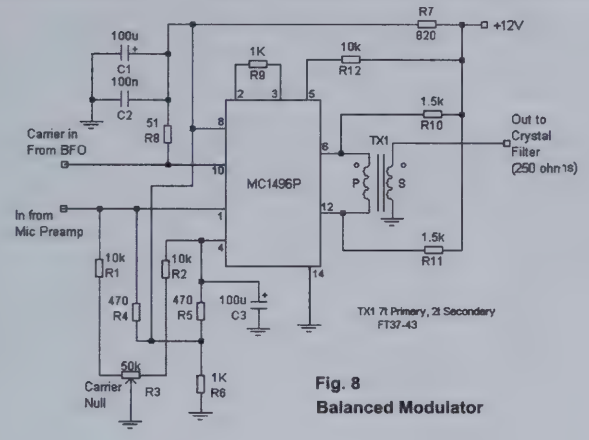


Fig. 8
Balanced Modulator

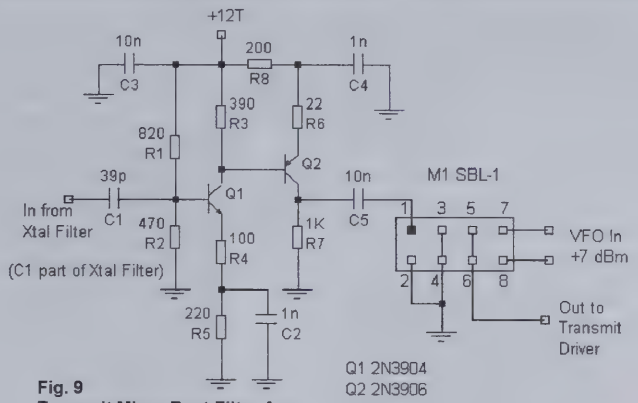


Fig. 9
Transmit Mixer-Post-Filter Amp

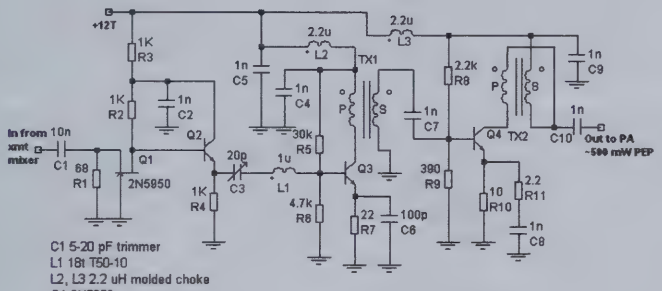

+12T
In from xmt mixer
Out to PA ~500 mW PEP
C1 5-20 pF trimmer
L1 18t T50-10
L2, L3 2.2 uH molded choke
Q1 2N5950
Q2 2N3904
Q3 TN2219A
Q4 2N5943 (or 2N5109) w/ heatsink
TX1 5t Primary, 1t Secondary on FT37-61
TX2 8t Bifilar on FT37-61

Fig. 10
Transmit Driver

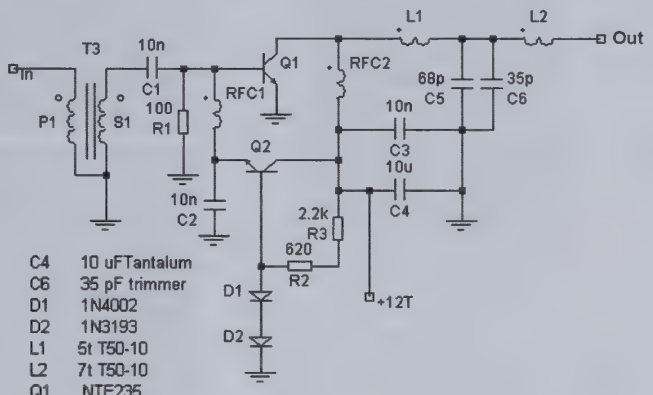


Fig. 11
5W PEP RF Power Amplifier

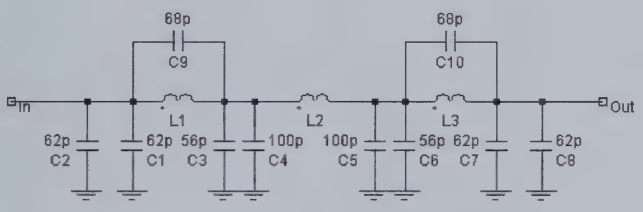


Fig. 12
Low-Pass Filter

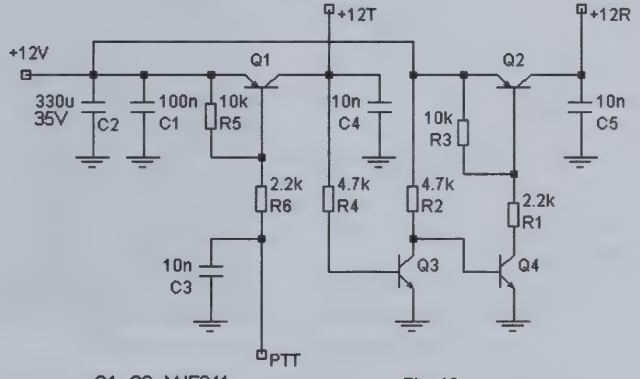


Fig. 13
T/R Switching

Circuit Lineup, Receiver:

3N204 LNA
Diode ring mixer
2N5950 mixer buffer
6 crystal ladder filter, 11.289 MHz, 2.8 kHz bandwidth
W7ZOI / WA7MLH Hybrid Cascode IF/AGC, kit-built
4 crystal ladder filter, 11.289 MHz, 2.8 kHz bandwidth
Diode ring product detector
2N5950 buffer
MPS-A14s Audio Lowpass filter
TDA2611A Audio power amplifier

Circuit Lineup, Transmitter:

2N3904 mic amp
MPS-A14 lowpass filter
MC1496 Balanced modulator
6 crystal ladder filter, 11.289 MHz, 2.8 kHz bandwidth
Diode ring mixer
2N5950, 2N3904 mixer buffer / BPF driver
TN2219A amplifier
2N5943 driver amplifier
NTE236 RF Power amplifier, 5W PEP output

Circuit lineup, oscillators:

2N3904s 11.289 MHz BFO and buffer
2N5950 Super VXO, 20.5 MHz
MPS2222 buffers
MPS2222 frequency tripler
MPS2222 VXO output
7.5 V Zener voltage regulator

Circuit lineup, T/R switching:

MJE341s, pass transistors
MPS2222s, switches

—Have fun on 6M SSB!

●●

Battery Dilemma—Great Planes Triton: Battery Charger Review

Richard Arnold—AF8X af8x@arrl.net

My involvement with portable QRP operation led me to search for some comprehensive battery information. Years ago there wasn't much of a choice, but now there are so many choices: alkaline, NiCds, NiMh, lead acid, and the newer Lithium-Ion and Lithium-Polymer cells. Each has their advantages and disadvantages. I preferred rechargeable batteries and have tried all of the battery types in that category. The more I read, the more confused I became as to which would best serve my purpose.

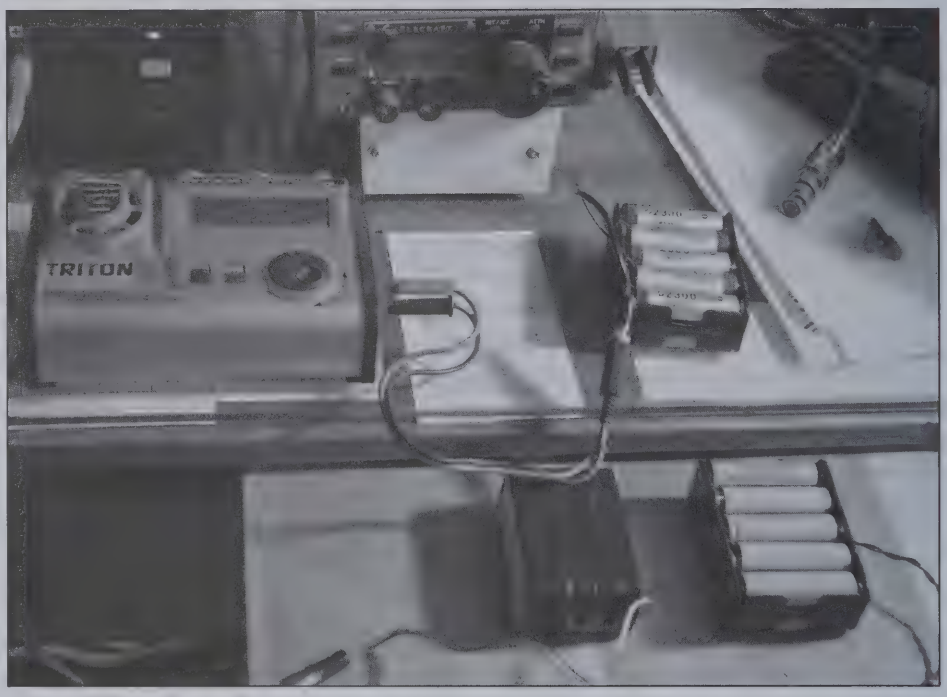
I have had a lot of experience with NiCd batteries during the pursuit of my radio control airplane hobby, so I felt comfortable using them, but keeping them charged, ready for use has its problems. We've all read about the dreaded "memory effect" associated with NiCds. It is recommended that you discharge them completely every few cycles to prevent "memory effect."

I turned to NiMH cells, which are claimed not to be troubled by the memory effect. They do have a high rate of self-discharge though, so the full charge is not retained for a very long period. Both NiCds and NiMh cells are only rated at 1.2-volts, so more cells are needed to build a 12-volt pack.

I have several sizes of 12-volt lead-acid gel cell batteries, which are very serviceable and hold a charge well; however, they are very heavy for their size.

After amassing a collection of all different types of rechargeable batteries, I needed a charger for each type. I decided to contact the person who I think knows more about batteries than anyone on earth, Red Scholefield. Red has a Web site loaded with battery information and he is happy to promptly answer your questions via email [1].

I emailed Red asking his advice on chargers. His reply came right back stating that in his opinion, for my use the Great Planes Triton computerized charger would fill my needs nicely. This unit will charge all types of batteries at the correct rate and even allows for discharge to charge cycles handy for NiCds. The charge cycles for the different cells are programmable and retained in memory. I bought a Triton and have been very happy with its performance for the past two years.



The top photo is a closeup of the Triton charger, while the bottom picture shows NiMH batteries being charged with other packs in line for charging.

The Triton charger does it all—from charging, discharging, cycling, trickle charge, peak detection and more all programmed and saved in memory.

The Triton charger also has safety features such as: precision peak detection with adjustable sensitivity for NiCd and NiMH batteries, cool-off time delay, maximum NiMH charge input, safety timer, current overload and reverse polarity protection and audible alarm. It comes with complete instructions and charts for the various battery types.

At $129.99 I believe it to be a bargain. Although designed for the Radio Control hobby, it has all the features needed to keep batteries healthy and long lived for portable radios and other uses. Most hobby shops probably carry the Triton charger, however I mail-ordered mine from Tower Hobbies [2].

References

1. http://www.rcbatteryclinic.com
2. http://www.towerhobbies.com

●●

The QRP-ARCI Toy Store

The **Official** QRP-ARCI Coffee Mug. Used by the top QRP Fox Hunters, contesters and casual operators found near the normal QRP Frequencies.
The Logo is on both sides. Coffee, tea or milk not included.

The QRP-ARCI patches are fully stitched, black on white. 3 9/16" wide X 2 1/2" high oval. And they can either be ironed on, or sewn on the finest evening wear! Also available in Blue & Brass metal pins

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Also available—Key holders (2/$1), Pens (2/$1) all with the QRP-ARCI logo, and most back issues of the QRP Quarterly.

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Checks made out to QRP-ARCI
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Covers the HW-7, 8 & 9 — Lots of new material!

See http://www.qrparci.org (QRP Toy Store link) for pictures

0911

Antennas 101: Planning Your Antenna System

Gary Breed—K9AY k9ay@k9ay.com

What do you want to accomplish with your antennas? We all have different desires, available time, financial resources, and of course, real estate. So how do we go about deciding what to use? Hopefully, this business-style analysis will help you decide on future antenna projects. It may also confirm that you are already on the right track!

Start the process by asking yourself a few important questions:

What is Your Operating Emphasis?

The first thing to do is decide what type of operating is most important. Do you like ragchewing with anyone on the band? Are you a DXer? Do you like contests? Your antennas should support your preferred style of operating. Of course, all QSOs are easier with better antennas, but your success in contests and DX chasing are greatly enhanced with higher performance antennas.

Are you a "minimalist" in your approach to QRP, preferring simple antennas that are easy to construct? Or are you more ambitious in your desire to maximize your low power signal with a top quality antenna system? Remember, even with "simple" antennas, there are still many performance choices among the various designs and implementations. For example, choosing between single-band dipoles at a proper height and a multiband antenna that is usually a compromise solution.

Also, what bands do you prefer? Are you a VHF enthusiast, a high bands aficionado, or a fan of the low bands? The size and height required for good performance varies a lot with the frequency of operation.

What is Your Time and Effort Budget?

I put this item second on the list because the amount of time you have available and your willingness to take on a significant ham radio project is often much more important than financial matters.

Time involves such tasks as doing your homework on various designs, searching out surplus and used bargains that can save lots of money, or doing a number of experiments with various antennas to see how they work on-the-air at your QTH.

The "effort" budget is similar, but maybe I should call this your "stick to it" capability! Gauge your willingness to put in the necessary time, put up with disappointing experiments, and be patient finding your way to the best choices.

What Are Your Technical Capabilities?

We all have different levels of knowledge, tools and equipment—both electronic and mechanical, since both are needed for antenna design, construction and testing. Where there are deficiencies, do you have good friends and mentors who can help you learn, or help you directly, to get the job done?

This is one of the most frustrating parts of designing and building the antenna system for many active hams who are still on the upward slope of the technical learning curve. I assume, since you've read this far, that you are really interested in antennas! Keep reading books and magazines—you *will* learn a lot, even if some concepts and most of the math is over your head.

Are you pretty good with your brain, but not with your hands (or vice versa)? Find a local ham who is the opposite—your computer and his toolbox may work together well to get things done at both of your stations.

With antennas, do not underestimate the value of mechanical aptitude! Most ham writeups emphasize computer models, impedance matching and other electronic portions of antenna design. But if you want to get that antenna in the air, and have it survive long enough to enjoy its performance, use the right materials and construction techniques.

What Practical Limitations Are You Stuck With?

The single biggest limitation is usually space—not all of us live on rural acreage that has enough room to build almost anything. Of course, money is probably the next biggest limitation, but creative scrounging and choice of construction methods can greatly reduce the financial impact. As noted above, your available time (and willingness to use it) is also important in this regard.

On the other hand, if you have achieved some success in life, you can overcome the limitation of too little time by buying commercial antennas and/or hiring someone to erect towers, bury feedlines, etc. This is especially true if another part of the hobby has your greatest interest—such as homebrewing, emergency communications, VE testing, and club activities.

Ultimately, it is these limitations that is the starting point for deciding on your optimum antenna system. It is easy to begin narrowing your antenna choices by eliminating this things you *can't* do!

Example 1—Good Performance on a Typical City Lot QTH

The majority of hams are just like the majority of all citizens. They live in town, with moderate property size, and proximity to other houses and utility infrastructure. It's not perfect for hamming, but many hams do very well from this type of location. (I was in this situation for 37 of my 47 years as a ham!)

Let's assume that you want "good" performance with as few compromises as possible. However, you also want to keep the neighbors happy and not disrupt your family's use of the yard.

Good performance requires height (See Figure 1). There is really no way around that fact, especially in town where there is a lot of clutter—a two-story house is 25-30 feet high, utility poles are 25-30 feet high and trees are as much as 70 feet high. If you have tall trees available, they may be part of the solution, but when it comes to performance, the first decision is whether to have a tower or not.

The various facts about towers are well-known. Local codes and ordinances may place limits on height, or at least complicate procedures. The size of your property, location of house, driveway, garage, etc. all have an effect. Cost is another factor, especially if you decide on a self-supporting or crank-up tower, which need more extensive excavation and a larger concrete base than a guyed tower.

Let's move ahead by saying you will have a tower: 55 feet tall, and "medium duty" like guyed Rohn 25 or one of the lighter duty crankup towers. With a mast to

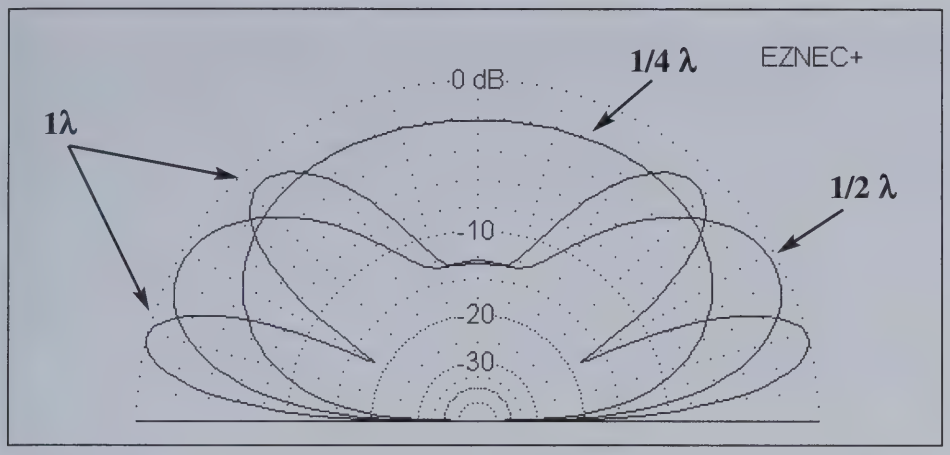

Figure 1—Vertical angle radiation for a dipole at three heights: 1/4, 1/2 and 1 wavelength. In the 20 meter band, these correspond to about 17, 35 and 70-foot heights. 1λ is good for DX with its low takeoff angle, 1/2 λ is good for domestic QSOs and some DX, while 1/4 λ radiates straight up, good only for very short skip.

support the antenna, the maximum overall height will be 60 feet.

In the interest of reduced visual impact, you choose a small tribander with a good reputation for performance and reliability. This covers the high bands with performance that will greatly exceed any wire antenna that will fit on a city lot. With a tower and rotator you can focus its performance in any direction. With little additional wind load, one or more VHF or UHF beam antenna can be added for improved performance above HF.

At the 55-foot mark, you can attach an inverted-V or use trees on the property to support the other ends of straight dipoles for the lower bands. There are many ham stations around the world with this type of setup—small tribander at moderate height, plus wires for 80M and 40M. It is a very workable balance of cost, complexity, visual impact, and transmit/receive signal performance.

Example 2—Same QTH, but Maximum Performance Without a Tower

In Example 1, the tower provides two things—height and physical support for a beam, including rotation. When these things are not possible, the achievable performance will be less, but perhaps not as much as you might think.

I found myself in this position several times in my ham "career," usually a temporary situation after moving to a new house and not being able to put up a tower for a year or more. This is where tall trees are a great benefit, but fortunately, not the only solution. Masts and elevated verticals provided some of the best performance in these situations.

Making the choice to concentrate on one or two bands also allows you to obtain better performance, with "big wires" like wire beams, Zepps, or a phased array. In my early years, I preferred 40M and 15M over all other bands. At one house, a 40M delta loop was suspended from a guyed aluminum mast that reached 45 feet high, while a classic ground plane on a chimney mount provided surprisingly good DX performance on 15M. A lot of good hamming was done with these two antennas. A more ambitious project at a rented house was a phased array of two 40M ground planes. These antennas were more than 50 feet high to the upper tips, but with sloping radials and careful arrangement of guy ropes, they did not intrude badly into the main part of the back yard.

A city lot provides plenty of space if you concentrate on one of the high bands—such as 20M, the prime QRP band. A dipole at 1/2 wavelength or more will work admirably. A 2-element wire Yagi or quad will add 4 to 5 dB in a favored direction for relatively little extra work.

To cover all bands, the one or two "big wires" for your favorite bands can be augmented with a G5RV or similar multiband antenna. If your big wires are on the low bands, a multiband vertical will provide coverage of the high bands without requiring a lot of room. Cross-polarization will minimize interaction with horizontal antennas.

There are many possibilities for covering one or two bands with really good wire antennas on a city lot. This is probably the means to obtaining maximum performance somewhere in the ham spectrum, without using a tower.

Example 3—Some Notes on Simple Antennas (and Some Things to Avoid)

I'll finish this note with a few comments on simple antennas for "low-impact" QRP, or which might be used for portable operation.

Once again, remember that height is the single biggest performance factor. Tall trees are great—find a way to get a rope up there! Boost the height of your house or garage by adding a simple aluminum or fiberglass mast, with rope and pulley to hoist wires. In other words, invest time and effort in your "vertical real estate."

This also means that you should avoid ground-mounted verticals on bands above 40M. Even on 40, you might want another horizontal antenna to cover different areas. The main reason to avoid these antennas is that that they have no gain—they are omnidirectional and do not take advantage of reinforcement by ground reflection. There is also good evidence that nearby clutter further reduces their effectiveness. In this regard, I have found verticals to be much more effective in portable situations where I am in a high, clear location.

Be careful with multiband antennas that use a tuner. Try to find out what the actual impedance is on each band, since tuner losses can become quite large when matching to extremes of impedance (either resistive or reactive part). It seems that all designs have one or more bands where the impedance reaches one of these extremes.

Don't forget that simple dipoles are efficient and effective. They have a convenient impedance for coax feed, they can be used on odd harmonic bands, and they are simple to build and adjust. The only negative is that you would need at least three of them to cover the major HF bands. As noted above, maybe you can use a dipole at a good height for your favorite band, and cover the rest with an antenna that is more of a compromise.

As a final thought—*all* electrical conductors will radiate. How well they radiate depends on their length, shape, orientation and height above ground, so take time to pick the right ones! ●●

QRP Contests

Jeff Hetherington—VA3JFF

contest@qrparci.org

Wow! It's hard to believe that as I write this column, I have to look forward and prepare for 2009. Seems like we just celebrated the New Year, and the time is fast approaching to do it again. 2009 will be another busy and exciting year in the world of QRP-ARCI Contesting, with the return of many favorite contest and sprints, and the introduction of a new contest suggested by the readers of this column.

The 2009 Contest Season will kick off with the new Pet Rock Celebration on 3 January 2009. This contest is designed to celebrate those cute crystal controlled rigs that we seem to have residing on the shelves in our shacks. This will be a three hour Saturday sprint and will also kick off the 2009 QRP Contest Championship.

The VHF Contest that was run in January last year has been re-allocated to the September contest slot. The rules remain the same, but the contest will now coincide with the ARRL September VHF Contest. Many of our members like to use this contest to get out portable from nearby hillsides, and the January time slot was not conducive to that in the northern climates of the USA, or here in The Great White North.

The only other change to the contest calendar this year was the removal of the End Of Summer Digital Sprint. This contest has suffered from poor participation in the past few years and will not be part of our 2009 offerings.

The 2009 QRP Contest Championship will include the following contests:

- Pet Rock Celebration
- Fireside SSB Sprint
- HF Grid Square Sprint
- Spring QSO Party
- Hootowl Sprint
- Summer Homebrew Sprint
- Silent Key Memorial Sprint
- VHF Contest
- Fall QSO Party
- Holiday Spirits Homebrew Contest

MARK YOUR CALENDARS!

Fall QSO Party
October 18-19, 2008

Top Band Sprint
December 4, 2008

Holiday Spirits Homebrew Sprint
December 21, 2008

Pet Rock Sprint
January 3, 2009

Winter Fireside SSB Sprint
March 14, 2009

The championship runs concurrently with our contest offerings, with each participant's best six results in these ten contests resulting in their QRP-ARCI Contest Championship score.

As for the summer season of contesting, the only word that seems to sum it up is NOISE. Everybody has been busy complaining that the noise is high in the north, unbearable in the south, and earsplitting on the coasts. Thunderstorms seem to be dominating every contest weekend, and the conditions at the bottom of the sunspot cycle are not helping reception of weak signals. The good news is that there have been increased reports of the start of a new sunspot cycle, and its affects should soon be seen and heard on the bands. The bad news, of course is that we need to hang in for a little bit longer with the poor conditions before it starts to improve.

Several of you have been braving this tough conditions to still complete in the QRP-ARCI events, and to those of you that have toughed it out, I salute you. In the Hootowl Sprint this past spring Bob Patten, N4BP, took top honors with a score of 21,252 pts. Stan Reas, K4UK, returned to the contest scene with a solid second place effort of 14,700 pts, and Tim Colbert, K3HX, managed another strong showing in third place with 13,860 pts. The milliWatt Field Day contest always proves to be one of the most satisfying weekends, and also one of the most fun. This year was no different with million point efforts from the Guano Beach Bashful Perverts, N4BP (2,653,714 pts), the QCWA Chapter 17 gang, W3GS (2,145,864 pts), and Dana A. "Mike" Michaels, W3TS (1,471,932 pts). Our final contest of this quarter suffered from the worst of the weather/noise phenomenon that we have been experiencing. Several noted the poor conditions along with their entries, but some operators still had strong performances. Arnold Olean, KØZK, took the victory home with 39,872 pts, a dominating total when you consider that Arnie didn't claim any bonus points. Second place went to Marc Ressler,

2009 QRP-ARCI Contest Schedule

2009 dates:	January 3	Pet Rock Sprint
	February 1	Winter Fireside SSB Sprint
	March 14	HF Grid Square Sprint
	April 4-5	Spring QSO Party
	May 31	Hootowl Sprint
	June 27-28	milliWatt Field Day Contest
	July 12	Summer Homebrew Sprint
	August 15	Silent Key Memorial Sprint
	September 12-13	VHF Contest
	October 17-18	Fall QSO Party
	December 3	Top Band Sprint
	December 20	Holiday Spirits Homebrew Sprint

The QRP-ARCI Contest Championship

The QRP-ARCI Contest Championship has been created in order to generate interest and participation among QRP operators in the contests sponsored by the QRP Amateur Radio Club International.

The QRP-ARCI Contest Championship (QCC) is operated concurrently with the regular contest offerings of the QRP-ARCI. Each operator that enters any of the contests listed below is automatically entered in the QCC. Please submit your entries to the below contests, no matter how small they may seem.

Eligible Contests: For 2009, the following 10 contests sponsored by QRP-ARCI will be eligible for the QCC. All contests count equally.

- Pet Rock Celebration
- Winter Fireside SSB Sprint
- HF Grid Square Sprint
- Spring QSO Party
- Hootowl Sprint
- Summer Homebrew Sprint
- Silent Key Memorial Sprint
- VHF Contest
- Fall QSO Party
- Holiday Spirits Homebrew Sprint

Scoring: Scoring for the QCC will be taken from the published results for each of the contests. The station placing first in each contest will receive a number of points equal to the average number of entrants in all of the QCC eligible contests from 2007. For the 2009 running of the QCC this number is 39. The station that places second will receive one less point, and so on, until either 1 point is reached, or the last entrant in the particular contest being scored is reached, whichever comes first. After that, zero points will be awarded for any additional entrants.

The final scores for the QCC will be the sum of the best six scores for each entrant. To be eligible for an award, an operator must enter at least three contests.

Awards: The person that is crowned as the QRP-ARCI Contest Championship Winner will be awarded a plaque suitable for hanging on their shack wall. Additional certificates will be awarded to the top scoring entrants in the championship.

K3NCO, at 27,600 pts, and third place was taken by Barry Ives, AI2T, with 18,500 pts.

Hopefully the worst of conditions are behind us now, and 2009 will bring better operating experiences for everybody!

Until next time, keep your power down and your QSO rates up.

—73/72, Jeff, VA3JFF

Summer Homebrew Sprint
Top 5 Results

KØZK	39,872	Arnold Olean
K3NCO	27,600	Marc Ressler
AI2T	18,500	Barry Ives
W8TM	18,295	Paul Kirley
W4RYW	14,050	Joseph G. Gay

Summer Homewbrew Sprint Soapbox

A late start (overslept after returning from IARU at a friend's house) only made worse by nothing working right. No RF coming out of rig so suspected RCA cable that had been a problem in the past. Put in another RCA cable, but didn't notice that I had melted the corner of the band socket, making it impossible to make contact with the last pin. In the meantime, I am madly checking out everything else with an ohmmeter and a dummy load. In desperation, I remove the RCA cable and replace it with two wires to an RCA socket. Then I noticed the bent pin on the band module and the melted connector. A little surgery allowed access to the connector socket and finally I was on the air—about 50 minutes late! Conditions weren't great; the QRN on 20 meters made it sound like 40, and by the time I hit 80 meters, I guess the storm was approaching—QRN was horrible! By the end of the sprint, I heard the rumble of thunder and as I am typing this I can hear the rain trickling down as I run around unplugging things. Doubt that I would have gotten much more in the way of QSOs even if I had started on time—a light showing, or really poor propagation (I heard a few ethereal chirps that I was never able to turn into callsigns, so I know there were others out there trying) but what do you expect at the bottom of the cycle?—**K3NCO**

Never heard 40m so dead. No signals anywhere on 15m. Signals were strong on 80m, but quite local. Thanks to all who answered my CQ.—**AI2T**

Conditions this weekend were poor, for both the IARU and ARCI events. This may be the first time that bonus points dominated the remainder of my score.—**W8TM**

Lots of storms in this area—QRN was bad but still had fun.—**W4RYW**

Very few stations on. Lots of QRN from storms.—**K3HX**

I operated on the grass next to the flight ramp at Newcastle County Airport Delaware on battery power. All was well till the rain an wind.—**AE3J**

Operated from the Patio at the Office—**WD9EYB**

I'm working at getting better. Special tnx to Steve for only club call.—**VE5BCS**

20m went out at about 2230 and 40m very in and out with rapid QSB. 40m more stable last hour. Hope for better next time.—**WØUFO**

Very poor conditions—**KØLWV**

Hootowl Sprint
Top 5 Results

N4BP	21,252	Bob Patten
K4UK	14,700	Stan Reas
K3HX	13,860	Tim Colbert
W4FMS	12,096	Frank Scutch
K4KSR	11,186	Bill Cunningham

Hootowl Sprint Soapbox—

Hard to get excited about this one after spending way too many hours in the CQ WPX. Also, bands very noisy due to lingering thunderstorms.—**N4BP**

Conditions not very good. QSB and

Summer Homebrew Sprint Results

Call	QTH	Score	QSOs	PWR	PTS	SPC	Bands	MULT	Bonus	Rig + Ant
KØZK	ME	39872		< 5W	178	32	20/40	7	0	
K3NCO	MD	27600	21	< 5W	90	20	ALL	7	15000	ATS-3
AI2T	NY	18500	13	< 5W	50	10	ALL	7	15000	K1-4+2 + Random Long Wire, Inv Vee
W8TM	OH	18295	17	< 5W	79	15	20/40	7	10000	K1 + 40m inv vee
W4RYW	AL	14050	9	< 1W	45	9	20/40	10	10000	K3
K3HX	PA	11844	26	< 5W	94	18	20/40	7	0	Orion I + 40m diople, triband rotary dipole
AE3J	DE	10364		< 5W	13	4	40	7	10000	HW-9 + 145ft inv L
WD9EYB	IN	10098	2	< 5W	7	2	20	7	10000	OHR Expoler II + 20m Voorhees Vertical
K7ZYV	MS	8500	10	< 5W	50	10	20	7	5000	
N6DIT	CA	6736		< 5W	31	8	20	7	5000	KX1 + G5RV
VE5BCS	SK	5063	2	< 5W	9	1	20	7	5000	HW8 + Long Wire
WB5FKC	TX	5040	1	< 55mW	2	1		20	5000	
AB8FJ	OH	5014	1	< 5W	2	1	40	7	5000	SW-40 + End-Fed Random Wire
WØUFO	MN	1715	7	< 5W	35	7	20/40	7	0	
KØLWV	MO	560	5	< 5W	20	4	20	7	0	IC718 + Longwire Vee Beam
NU7T	NV	532	5	< 5W	19	4	20	7	0	KX1 + TA33jr
KG2OR	NY	14	2	> 5W	7	2	40	1	0	Ten Tec Argosy + G5RV

QRN.—**K4UK**

Big QRN!—**K3HX**

Need to capture 80m noise to power rig!—**K4KSR**

Thanks to the stations that responded. The holiday may have affected turnout. Conditions not the best.—**WØUFO**

IC-703 on battery power 250 Hz filter and 3/4 wave inverted L with 30 radial wires. My wife, Robin, N3CJM, stayed at home with her sick mother, I went to the beach with the kids. The noise level was very high from a bad transformer in the campground but, the DSP and 250 Hz filter work great. Next year I will operate from my sail boat in the Delaware Bay.—**AE3J**

Bands went dead after about 10pm local time. One station west of the Mississippi and lots of QRN.—**KB3WK**

WOW. 40m very noisy, then things got worse. Thanks to all that persisted.—**KD2JC**

The OM AE3J went to the beach with the boys to operate. I was at home looking

Hootowl Sprint Results

Call	QTH	Score	QSOs	PWR	PTS	SPC	Bands	MULT	Bonus	Rig + Ant
N4BP	FL	21252	30	< 5W	132	23	20/40	7	0	K3 + A4S, 40/80 trap dipole
K4UK	VA	14700	24	< 5W	105	20	ALL	7	0	K2 + Inv Vee
K3HX	PA	13860	28	< 5W	110	18	40/80	7	0	Orion I
W4FMS	MI	12096	24	< 5W	108	16	20/40	7	0	
K4KSR	VA	11186		< 5W	94	17	ALL	7	0	K1 + Windoms, Inv L
WØUFO	MN	10192	20	< 5W	91	16	20/40	7	0	
AE3J	PA	6911		< 5W	39	7	40	7	5000	IC703 + Inv L
KB3WK	MD	6636	17	< 5W	79	12	ALL	7	0	K2
KD2JC	NJ	6636		< 5W	79	12	ALL	7	0	K2
W8TM	OH	5460	16	< 5W	65	12	40	7	0	K1 + Inv Vee
N3CJM	PA	5357		< 5W	17	3	40/80	7	5000	FT817 + Inv L
WB2DFC	OH	5315	3	< 5W	15	3	40	7	5000	FT817 + Wire
AI2T	NY	4389	12	< 5W	57	11	ALL	7	0	K1-4 + Random wire, Inv Vee
VA3RKM	ON	4060		< 5W	58	10	20/40	7	0	K2 + Verticals
WB3AAL	PA	3150	10	< 1W	45	7	ALL	10	0	K2 + Butternut HF9V, triband beam
W1PID	NH	2520	9	< 5W	45	8	ALL	7	0	IC703, Rockmite 80 + OCF Dipole
W2JEK	NJ	2400	8	< 1W	40	6	ALL	10	0	OHR-500 + 20m gr. plane, 40m dipole, 80m endfed Hz
WD7Y	NV	2240	14	< 5W	40	8	40	7	0	Orion 2 + Vertical
KN1H	NH	1890	9	< 5W	45	6	40/80	7	0	FT817
KF4AOM	KY	1813	8	< 5W	37	7	40	7	0	K2 + OCF Dipole
N6DIT	CA	1722	10	< 5W	41	6	20/40	7	0	FT301S + 700ft loop
W5TA	TX	1260		< 5W	30	6	20/40	7	0	
N8XX	MI	770	5	< 5W	22	5	40	7	0	Drake TR7 + 40m dipole
K8KFJ	WV	252	3	< 5W	12	3	40	7	0	
AB8FJ	OH	98	2	< 5W	7	2	40	7	0	

milliWatt Field Day Results

Call	QTH	Score	QSOs	PWR	PTS	Sec	Bands	MULT	Rig + Ant
N4BP	FL	2,653,714	873	< 5W	1739	218	ALL	7	K3 + 4BTV
K4KSR	VA	496,860	273	< 5W	546	130	ALL	7	K1
KIØG	CO	16,500	25	< 250mW	50	22	20/40	15	KX1 + Dipoles
K3WW	PA	725,900	774	< 5W	1525	68	ALL	7	K3, K1 + Dipoles
NØEVH	MO	290,304	144	< 5W	288	144	ALL	7	K2 + Doublet
AI2T	NY	66,220	110	< 5W	220	43	20/40	7	K1-4 + Temporary Random Wire
N6DIT	CA	28,224	63	< 5w	126	32	20/40	7	KX1 + G5RV
AD7L	OR	124,712	131	< 5W	262	68	20/40	7	FT817 + Hygain 18AVT
W3TS	PA	1,471,932	649	< 5W	1298	162	ALL	7	K2 + Doublets
N8BB	MI	981,288	531	< 5W	1062	132	ALL	7	
K6BBQ	CA	15,540	62	< 5W	74	30	ALL	7	FT817, FT857 + Buddipole/stick, Inv V, End Fed Half Wave
VO1BB	NL	1,260	9	< 5W	12	15	ALL	7	TS130V
ACØGP	MO	10,080		< 5W	60	24	ALL	7	FT817
WØRSP	SD	141,036	138	< 5W	276	73	20/40	7	KX1, Sierra
KD2MX	NJ	14,112	42	< 5W	84	24	20/40	7	KX1 + Longwire
K5ICW	TX	58,800	100	< 5W	200	42	ALL	7	FT817 + CF Zepp
KD2JC	NJ	167,608	185	< 5W	328	73	ALL	7	K2 + G5RV
VE3MGY	ON	47,294	442	> 5W	442	107	ALL	1	
WA5RML	TX	124,614	129	< 5W	258	69	ALL	7	Ten Tec Arognaut V + Dipole and Vertical
W5USJ	TX	240,366	147	< 5W	354	97	ALL	7	FT817 + 88ft EDZ
W8TM	OH	844,284	437	< 5W	874	138	ALL	7	K1 + Inv Vee
WB5FKC	TX	3,080	11	< 55mW	22	7	40	20	
K3HX	PA	307,146	213	< 5W	426	103	ALL	7	IC706 + Triband rotary dipole
W3GS	PA	2,145,864	750	< 5W	1272	241	ALL	7	2 x K2, IC703 + Dipoles, 4 ele 6m Yagi
VA3OVQ	ON	20,468	55	< 5W	86	34	ALL	7	K2, FT817 + Vertical, Doublet, Dipole

after a sick mother and made four contacts.—**N3CJM**

My 1st QRP Contest! Had a great time. I will be better prepared for the next contest.—**WB2DFC**

Short skip, lots of QRN. Didn't hear anyone new after second hour.—**AI2T**

Another noisy, Excedrin-headache event, with 80m absent. But glad to work so many in spite of the poor conditions. My thanks especially to N4BP for pulling my signal out on 40m and to W5TA for a 20m Texas contact when they came into the contest at 9pm EDT.—**VA3RKM**

Had a lot of fun. Received good reports running only 900mW. Fun contest, just wished the band conditions were better.—**WB3AAL**

Before quitting I fired up the 80m Rockmite. 500 mW and 3 stations! That was a hoot!—**W1PID**

Earsplitting QRN but good to hear the faithful coming through the noise.—**KN1H**

Great Contest! Band conditions died.—**KF4AOM**

Was looking forward to this nice little contest. What a let down. QRN level in TX on 40m was S9! Thunderstorms in OK, NE and throughout the Midwest. Got on late due to other commitments. 20m fair 'till about 02:00Z. Managed to work 2 on 40: W4FMS and WØUFO, but couldn't copy come backs to my CQ's. Folded after 40 minutes.—**W5TA**

Nice sprint, except the QRN was so bad I gave up after 1/2 hour.—**N8XX**

Only managed 2 QSOs on 40m, heard nothing on 80m or 20m.—**AB8FJ** ●●

QRP ARCI Contests are a handy excuse to get on the air instead of doing all those household chores! They also are excellent opportunities to work on QRP ARCI Awards like KMPW and the various Grids, Counties, WAS, WAC and DX awards.

Get on the air and raise the QRM level!

Contest Announcements

For All Contests:
Entry forms and log submission procedures can be found at www.qrparci.org. Logs can be submitted by e-mail to contest@qrparci.org, or by postal mail to Jeff Hetherington, VA3JFF, QRP ARCI Contest Manager, (Contest Name), 139 Elizabeth St. W., Welland, Ontario, CANADA L3C 4M3. Submit Logs along with a summary stating your Callsign, Entry Category, Actual Power and Station Description along with score calculation.

Results:
Will be published in *QRP Quarterly* and shown on the QRP-ARCI Web site.

Certificates:
Will be awarded to the top scoring entrant in each category. Certificates may be awarded for 2nd and 3rd place if entries are sufficient in a category.

2008 QRP-ARCI Top Band Sprint

Date/Time:
0000Z to 0600Z on 4 December 2008.

Mode:
SSB, CW or mixed modes. Work stations once regardless of mode.

Exchange:
Members: RST, State/Province/Country, ARCI member #
Non-Members: RST, State/Province/Country, Power Out

QSO Points:
Member = 5 points/QSO
Non-Member, Different Continent = 4 points/QSO
Non-Member, Same Continent = 2 points/QSO

Multiplier:
SPC (State/Province/Country) total for all bands. The same station may be worked on multiple bands for QSO points and SPC credit.

Power Multiplier:
(Use the smaller multiplier if operating mixed mode)

For SSB QSOs:
>10 Watts = x1
>2 - 10 Watts = x7
>500mW - 2 Watts = x10
>100mW - 500mW = x15
100mW or less = x20

For CW QSOs:
>5 Watts = x1
>1 - 5 Watts = x7
>250 mW - 1 Watt = x10
>55 mW - 250 mW = x15
55mW or less = x20

Suggested Frequencies:
CW: around 1810 kHz
SSB: around 1910 kHz
*Please remember that 1830 to 1835 kHz should be used for intercontinental QSOs only

Score:
Final Score = Points (total for all bands) x SPCs (total for all bands) x Power Multiplier

Categories:
Entry may be SSB, CW or Mixed Mode.

How to Participate:
Get on top band and hang out near the QRP frequencies listed above. Work as many stations calling CQ QRP or CQ TEST as possible, or call CQ QRP or CQ TEST yourself! You can work a station for credit once on each band.

Submissions:
Entries must be postmarked on or before 4 January 2009.

2008 Holiday Spirits Homebrew Sprint

Date/Time:
2000Z to 2359Z on 21 December 2008.

Mode:
HF CW Only.

Exchange:
Members: RST, State/Province/Country, ARCI member #
Non-Members: RST, State/Province/Country, Power Out

QSO Points:
Member = 5 points/QSO
Non-Member, Different Continent = 4 points/QSO
Non-Member, Same Continent = 2 points/QSO

Multiplier:
SPC (State/Province/Country) total for all bands. The same station may be worked on multiple bands for QSO points and SPC credit.

Power Multiplier:
>5 Watts = x1
>1 - 5 Watts = x7
>250 mW - 1 Watt = x10
>55 mW - 250 mW = x15
55 mW or less = x20

Suggested Frequencies:

160m	1810 kHz
80m	3560 kHz
40m	7030 kHz (please listen at 7040 kHz for rock bound participants)
20m	14060 kHz
15m	21060 kHz
10m	28060 kHz

Score:
Final Score = Points (total for all bands) x SPCs (total for all bands) x Power Multiplier + Bonus Points.

Bonus Points:
If operating a HB Transmitter add 2000 points per band
If operating a HB Receiver add 3000 points per band
If operating a HB Transceiver add 5000 points per band
(Homebrew is defined as: if you built it, it is homebrew (kits too!)

If you are operating PORTABLE using battery power AND a temporary antenna, add 5000 points to your final score. (You can NOT be at your shack operating from battery power using your home station antenna to qualify for this bonus.) This is to help level the playing field for contesters who work from the field against contest stations with 5 element yagis at 70 ft.

Categories:

Entry may be All-Band, Single Band, High Bands (10m-15m-20m) or Low Bands (40m-80m-160m)

How to Participate:

Get on any of the HF bands except the WARC bands and hang out near the QRP frequencies. Work as many stations calling CQ QRP or CQ TEST as possible, or call CQ QRP or CQ TEST yourself! You can work a station for credit once on each band.

Submissions:

Entries must be postmarked on or before 21 January 2009.

2009 Pet Rock Celebration

Date/Time:

1500Z to 1800Z on Saturday 3 January 2009.

Mode:

HF CW Only.

Exchange:

Members: RST, State/Province/Country, ARCI member #
Non-Members: RST, State/Province/Country, Power Out

QSO Points:

Member = 5 points/QSO
Non-Member, Different Continent = 4 points/QSO
Non-Member, Same Continent = 2 points/QSO

Multiplier:

SPC (State/Province/Country) total for all bands. The same station may be worked on multiple bands for QSO points and SPC credit.

Power Multiplier:

>5 Watts = x1
>1 - 5 Watts = x7
>500 mW - 1 Watt = x10
>200 mW - 500 mW = x15
>55 mW - 200 mW = x20
<55 mW = x25

Suggested Frequencies:

Please remember this is a contest is focusing on rock-bound transmitters/transceivers.

80m	3560 kHz
	3568 kHz
40m	7030 kHz
	7040 kHz
20m	14060 kHz
15m	21060 kHz
10m	28060 kHz

Bonus Points:

For crystal controlled gear add 2,000 points for using rock-bound receiver; add 3,000 points for using rockbound transmitter; or add 5,000 points for using rockbound transceiver. This bonus is available per band.

2009 QRP-ARCI Contest Schedule

January 3	Pet Rock Sprint
February 1	Winter Fireside SSB Sprint
March 14	HF Grid Square Sprint
April 4-5	Spring QSO Party
May 31	Hootowl Sprint
June 27-28	milliWatt Field Day Contest
July 12	Summer Homebrew Sprint
August 15	Silent Key Memorial Sprint
September 12-13	VHF Contest
October 17-18	Fall QSO Party
December 3	Top Band Sprint
December 20	Holiday Spirits Homebrew Sprint

If you are operating PORTABLE using battery power AND a temporary antenna, add 5000 points to your final score. (You can NOT be at your shack operating from battery power using your home station antenna to qualify for this bonus.) This is to help level the playing field for contesters who work from the field against contest stations with 5 element yagis at 70 ft.

Score:

Final Score = Points (total for all bands) x SPCs (total for all bands) x Power Multiplier + Bonus Points

Categories:

Entry may be All-Band, Single Band, High Bands (10m-15m-20m) or Low Bands (40m-80m)

How to Participate:

Get on any of the HF bands except the WARC bands and hang out near the QRP frequencies. Work as many stations calling CQ QRP or CQ TEST as possible, or call CQ QRP or CQ TEST yourself! You can work a station for credit once on each band.

Submissions:

Entries must be postmarked on or before 3 February 2009.

2009 QRP-ARCI Fireside SSB Sprint

Date/Time:

2000Z to 2359Z on 1 February 2008

Mode:

HF SSB only.

Exchange:

Members: RST, State/Province/Country, ARCI member #
Non-Members: RST, State/Province/Country, Power Out

QSO Points:

Member = 5 points/QSO
Non-Member, Different Continent = 4 points/QSO
Non-Member, Same Continent = 2 points/QSO

Multiplier:

SPC (State/Province/Country) total for all bands. The same station may be worked on multiple bands for QSO points and SPC credit.

Power Multiplier:

>10 Watts = x1
>2 - 10 Watts = x7
>500mW - 2 Watts = x10

>100mW - 500mW = x15
100mW or less = x20

Suggested Frequencies:

80m	3985 kHz
40m	7285 kHz
20m	14285 kHz
15m	21385 kHz
10m	28385 kHz

Bonus Points:

If you are operating PORTABLE using battery power AND a temporary antenna, add 5000 points to your final score. (You can NOT be at your shack operating from battery power using your home station antenna to qualify for this bonus.) This is to help level the playing field for contesters who work from the field against contest stations with 5 element yagis at 70 ft.

Score:

Final Score = Points (total for all bands) x SPCs (total for all bands) x Power Multiplier + Bonus Points

Categories:

Entry may be All-Band, Single Band, High Bands (10m-15m-20m) or Low Bands (40m-80m)

How to Participate:

Get on any of the HF bands except the WARC bands and hang out near the QRP frequencies. Work as many stations calling CQ QRP or CQ TEST as possible, or call CQ QRP or CQ TEST yourself! You can work a station for credit once on each band.

Submissions:

Entries must be postmarked on or before 1 March 2008.

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For All Contests:

Entry forms and log submission procedures can be found at www.qrparci.org. Logs can be submitted by e-mail to contest@qrparci.org, or by postal mail to Jeff Hetherington, VA3JFF, QRP ARCI Contest Manager, (Contest Name), 139 Elizabeth St. W., Welland, Ontario, CANADA L3C 4M3. Submit Logs along with a summary stating your Callsign, Entry Category, Actual Power and Station Description along with score calculation.

Results:

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Certificates:

Will be awarded to the top scoring entrant in each category. Certificates may be awarded for 2nd and 3rd place if entries are sufficient in a category.

QRP ARCI CONTEST ENTRY FORM

QRP ARCI CONTEST NAME: _____ **MODE:** _____

CALLSIGN: _____ **QTH:** _____ **ARCI #:** _____

MULTIBAND or SINGLE BAND (please circle one) **HIGHEST POWER USED:** _____

SUMMARY TABLE

BAND	QSOs	POINTS	S/P/C
160m			
80m			
40m			
20m			
15m			
10m			
TOTAL			

Enter Points and S/P/C Per Band

Please total each column in the Summary Table

Score Calculation Formula uses Totals

Mail this form along with your log of contacts to:

Jeff Hetherington, VA3JFF
139 Elizabeth St. W.
Welland, Ontario
Canada L3C 4M3
or email to: contest@qrparci.org

TOTAL POINTS	X	TOTAL # S/P/C/	X	POWER MULTI	+	BONUS POINTS	=	FINAL SCORE
_____	X	_____	X	_____	+	_____	=	_____

Total Operating Time: _____

Transmitter / Transceiver _____
Receiver _____

Comments _____
_____

Name _____ **CALL:** _____
Address _____
City _____
State/Province _____
ZIP/Postal Code _____
Country _____

Email (In case of questions) _____

QRP ARCI CONTEST LOG SHEET

ARCI CONTEST_____ BAND ____ UR CALL _____

Time	Station	RST Out	RST In	His State	His#/Pwr	Workspace

NOTES ON THE HISTORY OF QRP ARCI
Written by Mike Czuhajewski, WA8MCQ

The QRP ARCI club was originally started up in 1961 by the late Harry Blomquist, K6JSS, with the idea of voluntarily limiting power to 100 watts to reduce QRM on the bands and make ham radio more enjoyable. (Hams used input power in those days, not output like we do now.) The name then, as now, was QRP Amateur Radio Club International. The goals were laudable, although it was not what we'd consider a QRP club nowadays. (Don't forget that the term "QRP" actually refers to a reduction of power, not a specific power level, although common usage of the term now usually refers to power levels of 5 watts and below. The name and goals of the club were in harmony with the definition of the term.)

A number of people joined up when they heard the name with QRP in it and were disappointed when they found that it was not a true low power club. Many of them left, some stayed around. I was one of those who stayed around, although my primary interest was in "real QRP," with small, simple radios, etc. We were a barely tolerated lunatic fringe in the QRP ARCI, and the *QRP Quarterly* of that era had only rare tidbits on the subject.

I joined in 1967, with number 2706, and stayed around until I left ham radio in 1970 when I joined the Air Force. However, I did do my part for true QRP in those few years. I was on the Board of Directors in 1969 and 1970, I think it was. Except for the 1000 Miles per Watt award, which was in existence for some time already, the club awards (QRP DXCC, QRP WAS, QRP WAC, etc) were all for achieving those goals with 100 watts (input) or less. I proposed an additional award for working states (starting at 20) with 5 watts or less. The other BoD members agreed quickly, and I designed the certificate, wrote the rules, etc, and got one of the early awards myself.

In those days, the QRP ARCI also had Call Area Representatives, and I volunteered to be the one for the 8th district. Since my mother was doing the bulletin every week at church I had access to a mimeograph machine, so I started putting out an 8th district QRP ARCI newsletter called QRP/8 (every 2 months, I think). It was just another little newsletter except for one thing—since almost the very first issue I included a section which I called the QRP Corner, dedicated to news and projects of "true" QRP. After a while, Ade Weiss, WØRSP (K8EEG/Ø at the time) stumbled across a copy and went through the roof when he saw the QRP Corner—he found out he wasn't crazy, and he wasn't alone—there were OTHER people happily working with a handful of watts just like he was!

He immediately proposed that we chuck the QRP ARCI part and convert it into a 100% QRP journal, since the QRP Corner was why most of the people were subscribing in the first place. He suggested a name change, and I liked his idea of *The Milliwatt: National Journal of QRPp*. He took over the printing at the U of SD where he taught (and still does) and the rest is history. Ade did the bulk of the work on the new magazine himself, and I handled the subscription end. Even while I was still there he did all of the publishing work, and Ade deserves the credit for the vision that produced *The Milliwatt* out of QRP/8.

Although the total run of *The Milliwatt* was 33 issues, I left after 4 issues to join the Air Force, which was an attractive alternative to being drafted into the Army while Viet Nam was still hot.

Somewhere around 1977 or so, Tom Davis, K8IF (ex WB2TEN, a long time true-QRP stalwart) was president of the QRP ARCI and he proposed that it abandon the 100 watt focus and convert itself into a true QRP club, at the five watt level. Naturally this raised howls of protest from the Old Guard, but over a year or so he managed to slowly and diplomatically pull it off. The new focus of the QRP ARCI became "true QRP" and all vestiges of the 100 watt limit were eventually eliminated. The club was now dedicated to people who loved playing with flea power, although they could run higher power at any time, for any reason whatsoever (DX, nets, traffic work, ragchewing, etc). (I neglected to mention earlier that members had to sign a pledge that they would NEVER run more than 100 watts for any reason except, I believe, true emergency situations.)

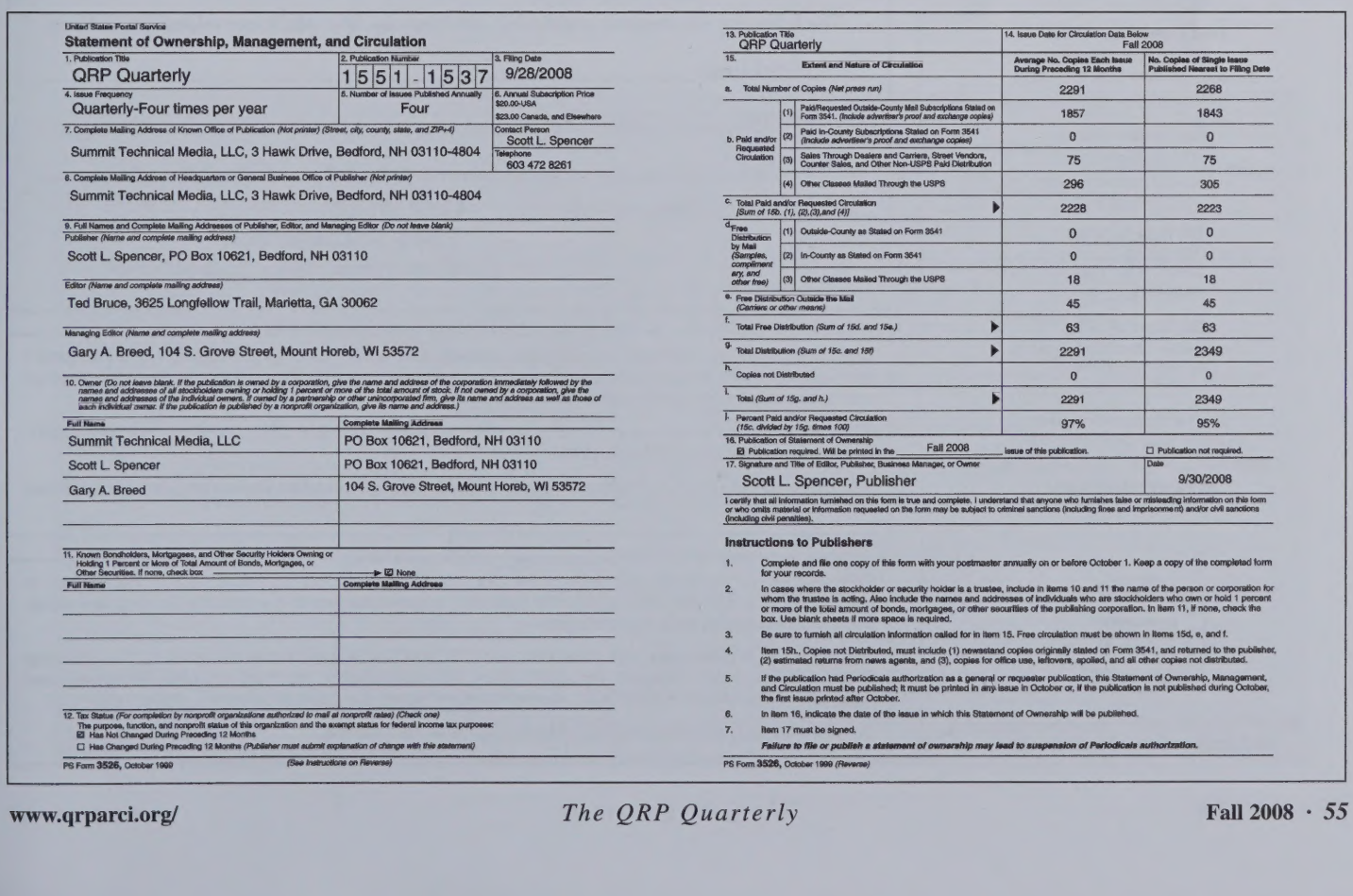
I didn't return to ham radio until 1986, and was overjoyed to find that the QRP ARCI was now a QRP club! I started writing for the *QRP Quarterly* in 1988 or so, and still do. I missed out on all the fun of the fight to turn it into a real QRP club, though K3TKS and many others were there and can tell stories about it.

While K6JSS founded a club that bore the name QRP ARCI, we have K8IF, Tom Davis, to thank for its conversion into a "true QRP" club and we all owe him a tremendous debt for that. Ade Weiss used to write a regular QRP column for *CQ* magazine, and in 1983 he wrote an excellent piece about Tom's work in making the QRP ARCI into what it is today. I asked *CQ* magazine for permission to reprint it in the October 1995 issue of the *QRP Quarterly* (page 6).

If anyone wants to "rejoin" the QRP ARCI and had a member number years ago, mention the fact when you write and they should be able to dig it out of the records and reactivate it. I believe that member number 59 is still active in QRP, or was a couple of years ago, but if N6MM rejoins he will take over the position of Lowest Active Member Number :-).

●●

(from the QRP ARCI Web site, edited)



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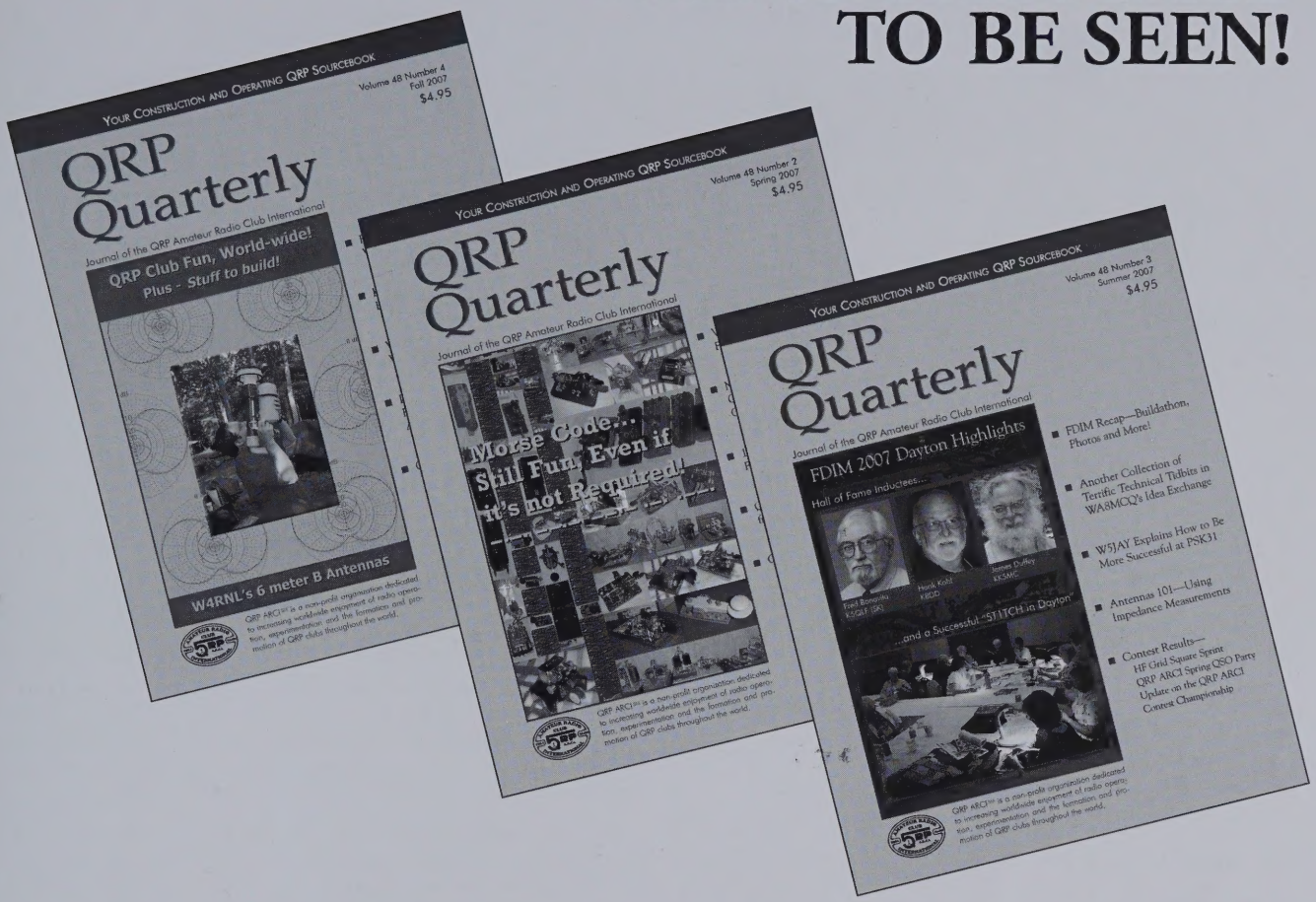
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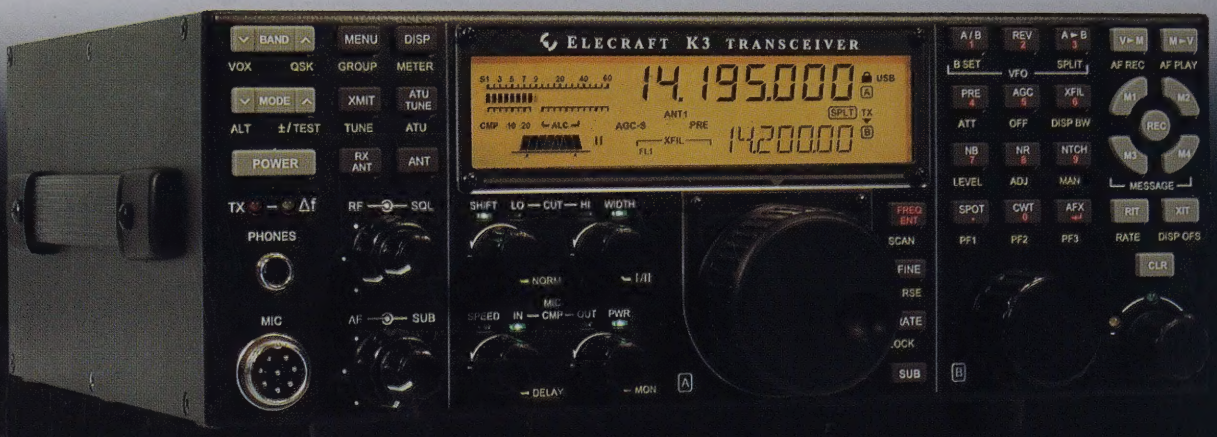

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